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S. HRG. 101-777

RADON TESTING FOR SAFE SCHOOLS ACT

HEARING

BEFORE THE

SUBCOMMITTEE ON
SUPERFUND, OCEAN, AND WATER PROTECTION

OF THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

ON

S. 1697

A BILL TO REQUIRE LOCAL EDUCATIONAL AGENCIES TO CONDUCT TESTING FOR RADON CONTAMINATION IN SCHOOLS, AND FOR OTHER PURPOSES

MAY 23, 1990

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RADON TESTING FOR SAFE SCHOOLS ACT

WEDNESDAY, MAY 23, 1990

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON SUPERFUND,
OCEAN, AND WATER PROTECTION,
Washington, DC.

The committee met, pursuant to notice, at 9:50 a.m. in room 406, Dirksen Senate Office Building, Hon. Frank R. Lautenberg (chairman of the subcommittee) presiding.

Present: Senators Lautenberg, Durenberger, and Baucus.

OPENING STATEMENT OF HON. FRANK R. LAUTENBERG, U.S. SENATOR FROM THE STATE OF NEW JERSEY

Senator LAUTENBERG. We're reconvening the Subcommittee on Superfund, Ocean and Water Protection for our hearing on S. 1697, the Radon Testing for Safe Schools Act. This bill, which Senator Chafee joined me in introducing, would require schools in radon-prone areas to test for elevated radon levels.

The bill recognizes two important facts. First, radon is one of the most serious environmental health risks facing the country today, and it's relatively simple and inexpensive to test for and mitigate elevated levels of radon. The threat posed by radon is clear. EPA estimates that as many as 20,000 people die of lung cancer each year from exposure to radon.

In 1988, EPA and the Surgeon General's Office issued a national health advisory urging people to test their homes for elevated levels of radon, and radon now appears to be a problem in our Nation's schools. In April 1989, EPA completed a survey which found that one in five classrooms had elevated radon levels and that over half of the schools tested have at least one classroom with elevated radon levels.

Our Nation's children are needlessly exposed to dangerous radon levels. That could be especially hazardous to the developing lungs of these young people. Fortunately, it is, as I've noted, relatively simple and inexpensive to test for and mitigate elevated levels of radon. EPA estimates that the average cost to test a school is roughly $1,000 and that the average mitigation cost is only a few thousand dollars per school.

Given these facts, it's inexcusable to simply ignore the threat posed by radon. The Congress has expressed its concern about radon in schools. In 1988, the Congress passed the legislation introduced by Senator Chafee, Senator Mitchell, myself and others re-

quiring EPA to conduct a national survey of radon in schools and to identify areas where schools exhibit high radon levels.

S. 1697 builds on this national assessment of radon in schools. It requires that once EPA has identified areas where schools exhibit high radon levels, local agencies test schools in those areas for radon by September 30, 1993. Test results would be made available to the public.

The bill authorizes $5 million to EPA through 1993 to help local education agencies test their buildings, and it authorizes $5 million annually from 1992 through 1996 to mitigate radon in school buildings in high radon areas that have been tested.

S. 1697 would expand our efforts to address the health threat that radon poses to our Nation's children. Testing and mitigating elevated radon levels in schools where children spend hours every day would significantly reduce their chances of exposure to lung cancer.

Today, our first witness is going to be Congressman Bart Gordon of Tennessee, who introduced the companion legislation in the House and is dealing with the legislation in the House and the problem of radon in the schools, and we look forward to hearing from the Congressman.

We welcome you and know how vitally interested you are in this legislation and look forward to working with you to see that we get it passed. It's a major problem, and when we first realized that radon was as big a problem that it is in the Pennsylvania, New Jersey, New York area, little did many of us—that eliminates me—here in this body realize how universal it was, and we began to discover in State after State and got more and more help on the legislation as people began to realize that there's hardly a State in this country that doesn't have some risk and some exposure.

We recently elected a new Governor who moved into a renovated, old Governor's mansion in the State of New Jersey, and we learned this week that he may have to move out because of elevated radon levels. It ain't funny, but it sure makes the problem one of great awareness to everybody.

So with that, I turn to my colleague and ask Senator Durenberger, any opening statements before we hear from Congressman Gordon?

Senator DURENBERGER. No, I just appreciate the Congressman's and everyone else's interest in the issue. People have been aware of this problem for a long time, they thought it existed in mines and places like that, and it's only recently that those of us who live in cold places in particular, if you look at a map where the largest concentrations are in this country, have discovered that for a variety of reasons we've sort of built the problem into our homes and into our dwellings.

I notice that now even if you want to sell a home around here, you've got to have a radon test of some kind, and I know somebody is making market for millions of dollars in testing equipment, and it is very helpful each time we come back to visit this issue as it relates to some kind of a private or public institution that we probably upgrade the level of our understanding of the problem, and I hope that that's what this hearing will do, Mr. Chairman.

Senator LAUTENBERG. Thank you very much.

Now, Congressman Gordon, we invite you to give your testimony.

STATEMENT OF HON. BART GORDON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TENNESSEE

Mr. GORDON. Good morning, Senator Lautenberg, Senator Durenberger. Being here and witnessing how efficiently the committee structure works in the Senate this morning makes me realize why so many of my colleagues are trying to come across the street and join you. I'm glad to have a chance, even though for a short time, to be with you today.

You are very aware of this problem, and so I'm going to, with your permission, submit my full testimony for the record and briefly summarize. I'd like to first thank Senator Lautenberg and his staff for all the time and effort they've put in to working together developing this legislation. I'm glad to be a partner with you in that, and I think that we have an excellent and very much needed piece of legislation.

As you know, radon is one of the indoor air pollutants that poses a special challenge. You can't see it, smell it or taste it, so it can be difficult to persuade people that radon really is dangerous, but radon is a killer, and, as you mentioned, it's the second leading cause of lung cancer in this country, resulting in over 20,000 deaths a year.

These are unnecessary deaths. Testing and mitigation for radon is relatively easy and inexpensive, and our challenge is to encourage this testing and mitigation both in homes and in schools.

I was noticing the other day, there was a recent survey, and there are surveys that come out periodically, but this was one that was in New Jersey, and it demonstrated once again, it was dealing with women, that women have a 40 percent higher chance of contracting lung cancer if they have exposure to heavy levels of radon. Once again, it confirms this.

I believe we have an even greater responsibility to reduce levels in schools, because children, because of their small lung capacity and their higher respiratory rates, are particularly susceptible to radon contamination. Following the enactment of the Indoor Radon Abatement Act last year, EPA conducted sample tests of radon levels in 130 schools in 16 States across the country.

It was interesting to note that in half of those 130 schools they found testing levels above the four picocuries, which, as you know, is the danger level, and in 20 percent of all the classrooms they tested, it was above this danger level. So certainly something needs to be happening.

I can also understand school administrators being concerned about the cost, being concerned about having one more responsibility. Yet, if you look at the facts, there's going to be a cost involved in lung cancer, whether it's 10 or 20 years down the pike. It's something not only in dollars but also human suffering is something that we need to certainly keep in mind.

So the bottom line, I think, is that radon testing and mitigation does save lives and it saves dollars. The Radon Testing for Safe Schools Act is based on this concept, that prevention is good public policy. It's a simple premise, and that premise is that parents have

a right to know if their children are being exposed to high radon levels. Teachers have a right to know if they're at risk, and so do schools employees.

The only way to find out about radon levels is to test, and the bill does mandate testing, but only in those areas that have radon problems. According to the bill, only those schools in the EPA-designated hot spots will be required to test for radon, and, again, the results will be made available to those parents, children and employees.

The testing is not complicated, nor is it expensive. Testing really involves no more than putting a $10 canister of charcoal down in your basement somewhere or in a school classroom. We do recognize that schools are being inundated with a variety of mandates now, and, because of that, we've also established a $30 million grant loan program to help those needy schools for the mandated testing.

But also we should note that any subsequent mitigation is voluntary. The bill does not mandate any kind of mitigation. It's our feeling that once this information is put before the schools boards, the parents, the teachers, employees, that they will find a way to work this out, and I think they can do it in an inexpensive way, often times doing nothing more than caulking windows, having additional ventilation.

To give a real quick example, in Tennessee, there were some of these schools that were tested, the 130 schools, and they found some of the highest levels in the Nation, over 136 picocuries, which is an enormous amount of radon and exposure, and the entire testing, mitigation, all the consulting work, the materials, the whole works was less than $25,000 for both of these schools, and certainly it's going to be difficult to find a situation that's going to be any higher or any more at risk than those two schools.

Finally, Mr. Chairman, let me point out that H.R. 3370 and S. 1697 have bipartisan support in the House and in the Senate. The measure has been endorsed by the NEA, the PTA, the American Academy of Pediatrics, the American Lung Association, the Consumer Federation of America, and the Coalition of Consumer Health and Safety.

I just once again want to thank you and your staff for your sensitivity and your help in helping to develop this legislation, and I look forward to trying to carry my own weight in water over on the House side for you.

Senator LAUTENBERG. We look forward to seeing that happen, and I would just ask the Congressman whether you want to speculate on the prospects for your bill in the House.

Mr. GORDON. Well, right now, as you might know, we are in the midst of clean air, and that has gotten people's attention, so the appropriate committees, quite reasonably, have been inundated with that. Hopefully, we're going to complete it today. If not, we'll complete it tomorrow. Then there will be some conferencing on it.

I have talked with Congressman Waxman, he has agreed to have a hearing, and so it's my hope that once we get this clean air out of the way that we can move expeditiously forward with this legislation.

Senator LAUTENBERG. We look forward to that. One of your distinguished colleagues from the Senate is chairing the Budget Committee. I serve on that committee with Jim Sasser, we work closely together, and I wouldn't want his assignment right now, but the fact is that I'm sure he'll try to help in whatever way he can as will Senator Gore, who has such an active interest in the environment and the health and well-being of the people in our communities.

Mr. GORDON. We realize that the budget does dominate everything we do here. I think that's one thing else about this bill. We've tried to be responsible with it economically and tried not to create an overburden——

Senator LAUTENBERG. These are very modest requests for a very serious problem, and I think it's obvious, as you pointed out, that people just don't take it seriously. We find out in the State of New Jersey that there are a lot of homes, a lot of facilities as yet untested. I took the opportunity to test whether my own home, a 60-year-old house in Montclair, New Jersey, had any radon. Unfortunately, we had our share, but it was in the corner of the house that's under a porch, and I had a little well and a sump down there, so we stay away from that corner of the house and hope that there have not been any effects over the years. But everybody's got it.

Senator Durenberger.

Senator DURENBERGER. No questions.

Senator LAUTENBERG. Thank you very much, Congressman. We look forward to working with you.

Now we'd like to hear from two colleagues in Government with whom we've had a chance to work over the years, distinguished Dr. Houk—you've testified here and there and everywhere before—and Mr. Richard Guimond. Dick and I have got to know each other through travels and interests in radon among other things, and we look forward to your testimony, and I'd ask Dr. Houk to deliver his testimony first, and we'll try to hold you to a five-minute presentation here, and I assure you that your full formal statement will be included in the record as it exists.

STATEMENT OF DR. VERNON N. HOUK, M.D., DIRECTOR, CENTER FOR ENVIRONMENTAL HEALTH AND INJURY CONTROL, CENTERS FOR DISEASE CONTROL

Dr. HOUK. Thank you, Mr. Chairman and Senator Durenberger. I'm Vernon Houk, the Director of the Center for Environmental Health and Injury Control at the CDC, and I'm pleased to testify on behalf of the Department of Health and Human Services on the subject of indoor air radon.

We are presenting detailed written testimony because of the scientific complexity of the radon issue, the public uncertainty about the individual and public health impact of exposure, and, in my opinion, some erroneous information periodically circulating in the press.

My written testimony can be summarized in one sentence. Indoor radon poses a very significant health risk, and the country should get on with doing something about it. A second two-part sentence is important. The exposure of a child to radon poses a higher risk

than exposure to the adults, and radon mitigation must be accompanied by very strong anti-smoking messages.

Radon was first identified as an occupational hazard to underground miners. However, our experience clearly demonstrates that miners are not the only person who may be exposed to elevated levels of radon. We know that the natural concentration of uranium and radon which are found in soil and rock throughout the United States pose significantly elevated levels of indoor radon.

The potent carcinogenicity of radon has been demonstrated consistently in human and animal studies over many years. Excess lung cancer has been reported in numerous studies of underground miners exposed to radon. CDC's National Institute of Occupational Safety and Health has conducted studies which show an increased risk both in smoking and non-smoking American miners.

The estimates of the risk to humans for most environmental carcinogens must be extrapolated from studies of animals exposed to very high levels of the suspected carcinogenic agent. However, risk estimates for indoor radon are based on human rather than animal studies.

While early studies of miners consisted primarily of populations with cumulative exposures higher than once thought possible in the general population, more recent studies show an increased risk at cumulative exposures that are attained by living in a house with elevated radon.

In the Reading Prong area of Pennsylvania and indeed some areas of your own State, Mr. Chairman, 40 percent of the homes tested had levels high enough of residents to accumulate exposures in the range of excess risk demonstrated in the miners. The National Academy of Science evaluated studies of lung cancer in miners and published a report in 1988 which estimates the risk to the general population from radon progeny.

There are, of course, many differences between a typical resident home and a school, I might add, and a working miner. However, after evaluating all the factors that influence the radiation dose to the lungs from radon progeny and how these factors vary between a mine and a normal household, the committee concluded that the radiation dose to the lung in a mine is about equal to that in a home at the same level of exposure. This is a very important considering in applying risk estimates for miners to the general population.

Mr. Chairman, I would also like to note that children are particularly sensitive to the effects of radiation. In general, children are more sensitive to the health effects of radiation. In addition, estimates to the dose of children indicate that they receive a higher radiation dose to their lungs than adults for the same level of exposure.

For example, a child of 10 receives two times the lung dose of an adult exposed to the same radon level. The International Committee of Radiologic Protection and the National Academy of Science both support the view that individuals exposed under the age of 20 have a higher risk of developing lung cancer to those exposed later in life. Data from the Japanese atom bomb survivors support this view.

Smokers, certainly active and probably passive, should also be considered a special population because of the risk from radon. Although smoking is the major cause of lung cancer and is associated with over 100,000 deaths per year, radon exposure appears to multiply this risk. The National Academy of Science committee referred to earlier reports smokers have at least a 10-fold increase compared to that among non-smokers to the same level of radon.

In addition to radon mitigation, anti-smoking individuals is vital to any public health program on indoor radon. Not only should individuals be encouraged not to smoke, but they should prohibit smoking in their homes. This latter is important, because the radon progeny attaches to particulates in cigarette smoke, which thus become an efficient vehicle to get radiation into the lungs.

Tables from the National Academy of Science report on radon are included in our written testimony. Based upon this, the risk of dying from lung cancer for the general population increases 40 percent due to lifetime exposure of radon progenies at EPA's recommended level of action. The lung cancer risk from indoor radon at that level is about 200 times greater than at 30 years of asbestos exposure at 1/100th of a fiber per cc of the EPA action level for buildings.

It is also 100 times higher than the risk of fatal cancer that is considered acceptable for other naturally occurring radiation regulated by EPA, such as uranium and radium in water.

Ongoing collaboration between CDC and EPA has led to the development of remedial action guidelines on residences, indoor air radon measurement protocols, and the informational packet "A Citizen's Guide to Radon." CDC will be working with EPA on the revision of the Citizen's Guide this year and will continue to pursue a collaborative radon effort not only with EPA but with other Federal agencies.

To put our action where our mouth is, with respect to our own employees, CDC has completed an extensive testing program for indoor air radon in our own buildings. We have also recommended that employees test their own residence and are providing guidance on screening and follow-up measurement techniques and recommendations for remedial actions.

If there is time in the question period, I'd like to present a remarkable commitment and success of another Federal agency. As you can tell, CDC considers indoor radon an important environmental health issue. An individual cannot easily control his or her risk for most environmental contaminants. Like smoking, however, the indoor radon problem is unique, because with the right information and encouragement, individuals can take action to reduce their own risk and the risk of their families from radon in buildings.

Hopefully, that action will include not only concern about their own homes and smoking, but a demand that the child's schools and other places where the child spends considerable time indoors be tested for radon and, where found, mitigated.

This concludes my testimony, Mr. Chairman, and I'll be happy to answer any questions.

Senator LAUTENBERG. Thank you very much. Now we'll hear from Richard Guimond. Mr. Guimond accompanied me on a trip to

Sweden where we reviewed the problems that they have with radon and how they deal with it, and they deal with it very promptly. They don't render the land useless or the buildings useless. They mitigate with fairly simple systems at a fairly low cost.

We're glad to have you here, Dick, and invite you to give your testimony in summary form.

STATEMENT OF RICHARD J. GUIMOND, DIRECTOR, OFFICE OF RADIATION PROGRAMS, OFFICE OF AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Mr. GUIMOND. Thank you very much, Mr. Chairman, Mr. Durenberger, Mr. Baucus. I'm very pleased to discuss with you EPA's radon program. I will provide my entire testimony for the record and just summarize today.

Senator LAUTENBERG. It will be included.

Mr. GUIMOND. We appreciate the committee's longstanding interest in this serious health problem. This committee has played a very key role in enactment of the Indoor Radon Abatement Act, and committee members have demonstrated national leadership in addressing radon in homes and schools through support of effective approaches to training and State program development.

I'd particularly like to thank Senator Lautenberg and the subcommittee for introducing the resolution designating National Radon Week. This resolution, we believe, will be very important in encouraging increased testing in homes and schools.

Before beginning to talk about the Radon in Schools Program, I'd like to put our radon problem in context. Indoor radon contamination is one of the most important environmental health problems facing our country today. EPA and several national scientific organizations estimate that radon, as you know, is the second leading cause of lung cancer in America.

We believe that approximately eight million homes in America, or nearly 10 percent, may have annual average concentrations above our current action level of 4 picocuries per liter. Based on that information, EPA and the Surgeon General have recommended that all homes below the third floor be tested for radon and elevated levels lowered.

We are particularly concerned about risk to children. The International Commission on Radiological Protection has estimated that risk to children may be two to three times higher than the risk to adults. The Agency believes it is prudent public health policy to protect children from significant sources of exposure.

Since the discovery of radon problems in homes in early 1985, EPA has designed a program to address all aspects of radon risk reduction through a non-regulatory partnership with States and the private sector. The program was designed based on the belief that radon reduction is best achieved through a concerted effort of Federal and State expertise and resources and through informed public action.

We believe that this same approach is well-suited to address the radon problem in schools. Two important pieces of legislation charted our course. First, the Radon Gas and Indoor Air Quality Research Act of 1986, the amendments to SARA confirmed our di-

rection in problem assessment, research and technology, and then in 1988, the Indoor Radon Abatement Act directed EPA to undertake a broad range of new activities to achieve the national goal of making indoor air as free from radon as the air outside.

Both of these laws have focused on schools as well as homes. Our approach in identifying and addressing radon in schools has closely followed the model that we developed for homes: assess the problem, develop appropriate mitigation technology, provide technical assistance to develop State and private sector capabilities, and educate the public so they can make informed decisions about radon.

States need to and are taking a lead in addressing the radon problem at the State and local level with financial and technical assistance from the Federal Government. They all have an existing network of environmental, health, and radiation protection agencies that we're trying to fully plug into to make this work. Some of the activities we're providing at the Federal level are assistance in problem assessment, design of effective programs, and technical training assistance.

Let me now turn specifically to schools. On April 20, 1989, EPA's Administrator, William Reilly, issued a national advisory recommending that all schools be tested for radon. At the same, we provided technical information to schools on how to go about doing that. Our recommendations were based on the study that you spoke about earlier that found elevated levels of radon in many schools throughout the United States.

Unfortunately, as with homes, the only way to know if a school has a radon problem is to test. While school testing and mitigation can successfully use many of the approaches developed for homes, radon concentration in schools are influenced by special factors such as building construction, ventilation, air conditioning systems and the like.

Let me also summarize for you a few of the EPA activities in assessing radon in schools. In 1989, EPA conducted a study of radon levels in 130 schools in 16 States. Key findings were that elevated levels were found in each of the 16 participating States, and rooms in contact with the ground had the highest radon levels.

We are currently expanding our program by designing a national school survey, as required by IRA. The results of this survey are expected in about two years and will provide a picture of radon in schools across the country. However, we won't find all the problem areas. Individual schools still need to be tested.

EPA has a number of activities underway to develop effective mitigation technologies. The agency has undertaken initial investigation in several States throughout the country. What we find is that the types of techniques useful in homes are applicable to many schools, although other techniques may be applicable because of unique characteristics of schools.

Testing a school is relatively inexpensive compared to other costs incurred by schools. If school personnel are used to deploy radon measurement devices, the typical school can be tested for under $1,000. Costs of radon reduction will be school-specific, but based on our very limited experience to date, we estimate that diagnosing the problem and determining what to do will cost approximately $2,000 to $5,000 per school, and then most schools could be expect-

ed to be fixed for an additional $3,000 to $15,000. However, some particularly difficult schools may cost more.

To put these costs in perspective, the average cost for asbestos mitigation under EPA's Asbestos School Hazardous Abatement Loan and Grant Program is about $200,000 to $220,000 per school and can be over $1 million in difficult cases. As I've noted before, we expect schools to be able to reduce their radon levels at much less cost and, in many cases, simultaneously address other indoor air quality problems. We found radon reduction in houses to be very cost effective and expect the same and possibly better results in schools.

Over the past few years, EPA has been trying to expand our public awareness of radon problems in schools. Our goal is to assist States in educating the public about radon risks and the need for action. We've done a number of these things for schools by working closely with the National Education Association, Parent-Teacher Association, and others. For example, we have developed a Radon-in-Schools brochure in allocation with these organizations.

In conclusion, EPA and many members of the scientific community believe that radon is an important health risk. We recommend that all schools be tested and are actively working with the States and educational organizations to do so. We believe our current approach can be effective for schools as well as homes. We need to evaluate how things are going under the current program before we make additional changes.

EPA will provide the committee with our technical comments on S. 1697 for the record, but at this time believe it is inappropriate to include any additional legislation. The Agency and the Administration oppose any legislation that establishes a new additional grant program for radon testing in schools. Thank you.

Senator LAUTENBERG. Thank you very much, Mr. Guimond.

Before we begin the questioning, I would ask if my distinguished colleague from Montana has a statement.

Senator BAUCUS. Not at this time, Mr. Chairman.

Senator LAUTENBERG. I thank you both for your testimony. I'd like to ask either of you for your view on how you characterize the evidence concerning the health threat posed by radon compared to other environmental contaminants which we control.

Dr. HOUK. The evidence on radon is the strongest of any environmental contaminant because our extrapolations and our estimates are based upon human observations at the level that we're talking about at risk. There is no room for debate on this issue, Senator Lautenberg. Anybody who tells you differently is ill-informed, deceitful, or both.

Senator LAUTENBERG. Well, why can't you be more definite? [Laughter.]

Mr. GUIMOND. We would agree with Dr. Houk, that the scientific information here is exceedingly strong. I was, for example, a year or so ago at a meeting at the World Health Organization that debated the strength of various evidence for various chemical carcinogens. It's called the International Agency for Cancer Research, and it took about 20 gentlemen in the room, experts from all over the world, about 10 seconds to unanimously agree that this in fact was a human health carcinogen and a very strong one.

Senator LAUTENBERG. Mr. Guimond, in March, the Washington Times published a commentary arguing that radon presented minimal risk to public health. This came up as a piece of evidence in our clean air debate referring to those zealots who are out looking for regulation. Are you familiar with the author's arguments?

Mr. GUIMOND. Yes, I'm familiar. That author quoted me a couple of times in the piece.

Senator LAUTENBERG. Right. Your response?

Mr. GUIMOND. We believe that the author is misinformed or miscalculated a number of things. One of his points was, for example, that if in fact there was as much radon as we thought might be in Iowa, then there should be 1,600 lung cancers in Iowa due to radon, and there are only 1,400 lung cancers per year in Iowa now, so obviously we were wrong.

He miscalculated and misused the data that we had. Our estimate would say that there are maybe 300 to 400 lung cancers in Iowa that would be related to radon, so it's very consistent with the overall rate.

In addition, he used a number of studies——

Senator LAUTENBERG. You said Iowa?

Mr. GUIMOND. Yes, Iowa.

Senator LAUTENBERG. Okay.

Mr. GUIMOND. In addition, he used a number of studies inappropriately. He used some studies in China that he believes show that there is no increased lung cancer in areas that they concluded were high radon areas in China. But if you looked at the actual studies, you would see that the "high radon areas" of China where they did the study had less than two picocuries per liter, and as you know, Senator, that is not much of a high radon area. So it is just very inappropriate data.

We responded to the article with a letter to the editor, and we had some inquiries from Senators and Congressmen and responded with more technical information to that, too.

Senator LAUTENBERG. If you'd furnish your response to that article so that we have it in the record.

[The response referred to follows:]

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

APR 2 1990

Letter to the Editor
The Washington Times
3600 New York Avenue, N.E.
Washington, DC 20002

Dear Editor:

Enclosed please find a Letter to the Editor in response to Warren Brookes' Commentary "Killer or minimal risk" which appeared in the March 8, 1990 edition of your paper.

Thank you for the opportunity to express an opposing opinion.

Sincerely yours,

Michael H. Shapiro
Deputy Assistant Administrator
for Air and Radiation

Enclosure

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RADON: A VERY REAL HEALTH THREAT

Dear Editor:

Warren Brookes' March 8, 1990 commentary on radon, "Killer or Minimal Risk," that appeared in your paper contains many disturbing inaccurate statements and conclusions. Radon, contrary to the opinion expressed in the article, is a very real health threat. Radon is one of only a handful of substances known to cause cancer in humans. The Environmental Protection Agency (EPA) estimates that radon contributes to about 20,000 lung cancer deaths annually in the United States.

EPA's position is supported by the National Academy of Sciences, The U.S. Surgeon General, the American Medical Association, and the Centers for Disease Control. These organizations have all identified radon as a serious health threat. In addition, reports from the World Health Organization, the National Council on Radiation Protection and Measurement, and the American Lung Association confirm that radon is a serious health risk.

Mr. Brookes' commentary attempts to refute the conclusions of these organizations. However, in doing so, the commentary presents much information that is inaccurate or untrue.

The commentary cited many studies which compared regional lung cancer rates with regional radon levels. These crude calculations present many problems. Primarily, average radon levels do not reflect an individual lung cancer victim's exposure to radon. Additionally, these studies do not account for smoking habits, age, or length of exposure of the people who died of lung cancer. This is like deciding that warm weather is bad for you if you found that death rates in Florida were higher than in Maine.

The commentary also used a study of two Chinese provinces with extremely low levels of radon and only 5 lung cancer deaths. This study was used to assert that radon does not cause lung cancer and to criticize EPA's risk estimates. In fact, EPA's risk estimates are based on large studies including 700 lung cancer deaths in a population of 27,000 miners exposed to radon. Only 200 lung cancer deaths would normally be expected in this population.

The commentary also stated that lung cancer deaths only occurred in these miners at radon levels 3000 times greater than EPA's action level in homes. This is wrong. In fact, many homes have radon levels that would expose residents of five to fifty years to more radon than miners who contracted lung cancer.

The commentary also falsely portrayed England's public health policy on radon. The commentary implied that "England was willing to wait until 1993 for the results of [a particular large] study" before taking action on the radon problem. Contrary to this assertion, England is taking fast action against radon. In fact, Great Britain's National Radiation Protection Board has just reduced their radon action level for existing homes from 10 to 5 picocuries per liter (pCi/L). (EPA's current action level is 4 pCi/L.) Great Britain has also set a limit of less than 3 pCi/L in new homes.

The commentary also attempted to use data on radon levels in Iowa to question EPA radon risk estimates. It suggested that EPA estimates would predict 200 more lung cancer deaths in Iowa from radon alone than actually occurred from all causes in 1988. This is not true. The author incorrectly combined national and state data to estimate annual radon lung cancer deaths in Iowa. Even if this approach had been valid, the calculation was performed incorrectly. The author arrived at 1600 annual lung cancer deaths; correct calculations would have led to 400 annual deaths. Thus, not only was an invalid procedure used, the calculations were incorrect.

There is solid scientific proof of radon's serious health effects. There is evidence of elevated radon levels in homes throughout the country. Millions of people will continue to be exposed to dangerous levels of radiation until homes with radon problems are identified. Fortunately, radon is a health hazard with a simple solution. EPA and the Surgeon General have recommended that most homes be tested for radon. Houses with high levels should be fixed. Delaying prudent public health actions until the evidence is even more compelling than now would be irresponsible.

Michael Shapiro

Michael H. Shapiro
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for Air and Radiation
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Senator LAUTENBERG. Dr. Houk.

Dr. HOUK. Senator, most of these arguments are based upon ecological studies which are not possible to be done without a great deal of cost. The reason for that is the latency period for the tumors are 30 or 40 years, or may be that long. Thirty percent of the population of the United States that lived in a single county in 1975 no longer lived in that county in 1980. There's a great deal of movement about.

There's compounding factors such as smoking, with detailed occupational information. We have estimated that to absolutely prove something that we already know, that we have good evidence for, it would take a study of about 10,000 lung cancer cases and 10,000 randomly selected controls at a cost of about $100 million to do, and it is our view that the expenditure of $100 million best be done on mitigation rather than continued studies.

Senator LAUTENBERG. Mr. Guimond, Dr. Houk's testimony says that the increased risk of lung cancer from radon exposure is 4,000 for every one million persons exposed at the EPA action level. Does EPA agree with this risk estimate?

Mr. GUIMOND. There are obviously variable risk estimates, but we don't disagree with the general conclusions of Dr. Houk.

Senator LAUTENBERG. Is this risk significantly greater than other environmental risks?

Mr. GUIMOND. Yes. EPA did a study a little over a year ago to look at all the various environmental pollutants that EPA is dealing with and concluded that indoor radon was the single largest pollutant that EPA's programs are trying to deal with at this point.

Senator LAUTENBERG. A recent study published in the Journal Lancet associates radon with leukemia and other cancers. Have either of you reviewed the study, and, if so, do you find it credible?

Mr. GUIMOND. We've looked at that study. That is a fairly recent piece of work. Prior to this, I don't think there was much evidence that radon would cause cancers, other than lung cancer, of particular significance. I think that is also on an ecological study. That is, they just looked at leukemia rates in various foreign countries and the average levels of radon.

We believe that the study is fairly weak, but we are continuing to work with some of the investigators there to look at it more thoroughly. We don't want to dismiss it, but I would have to say that it's far from definitive at this point in time.

Senator LAUTENBERG. What do you think, Dr. Houk?

Dr. HOUK. The radiation that's associated with the radon penetrates only a very few millimeters, and that's the reason the lung is the target area. I've seen the study, it's an ecological study, I'm cautious of it, I don't necessarily believe it, because it's hard for me to see how the narrow range of penetration could affect the bone marrow from breathing the radon into the lungs.

Senator LAUTENBERG. And leukemia?

Dr. HOUK. The radiation leukemia is generally caused by radiation of the marrow.

Mr. GUIMOND. The investigators postulate that there is a mechanism by which when you breathe in the radon, the gas is absorbed into the blood stream and that's how individuals get doses other

than to the lungs and that's a very new finding. We are trying to track down some of the papers they reference, but that would be something new that I don't think is established in the scientific community yet.

Senator LAUTENBERG. Dr. Houk, you say that the risk to children is higher from radon exposure than adults. What's the yardstick for measurement there? How much more risky is the exposure to children?

Dr. HOUK. The risk of radon to the lung is dependent upon the size of the lung and the amount of air breathed in and the particular size and where it is deposited. Basically, it's about two times higher in young children because their lungs are smaller and they're breathing a lot more in per dose exposed. If you had 10 particles in the air, the chance of one particle getting into the lung would be two for children versus one for an adult.

May I correct one thing, because other people will say that we don't know what we're talking about. We did not say that the risk for radon in those exposed is 14,000 per million. This is a relative risk. It's 40 percent higher. The risk of lung cancer is 10,000 per million of people not exposed and 14,000 per million of people exposed.

Senator LAUTENBERG. I see.

Mr. Guimond, what evidence do we have that schools are in the testing mode for radon?

Mr. GUIMOND. Well, as we have begun to implement the Indoor Radon Abatement Act, one of the things that we made we said to States is that some of the grant resources they received could be used for schools. Some States are using some of their resources for testing in schools. For example, the State of Colorado has made it mandatory that schools be tested, and we're seeing some initiatives like that in a few States. A few States are testing schools on a voluntary basis.

Clearly, all schools are a long way from having been tested, and it's going to take a while for that to happen because of individual priorities and activities, but we do see schools beginning to move in that direction, and they may be moving in that direction more quickly than they moved in the direction of testing for asbestos.

Senator LAUTENBERG. What's the basis that EPA uses in areas where high radon concentrations exist?

Mr. GUIMOND. Do you mean, what would we designate as a high risk area?

Senator LAUTENBERG. What's the basis for your selection for focusing on an area of high concentration? Is there a mapping procedure?

Mr. GUIMOND. Yes, we're in the process of developing a nationwide map, as requested by the Indoor Radon Abatement Act, and that map will look at the likelihood of having high levels in houses, the likelihood of having geologic conditions that promote radon levels and the porosity of the soil.

Now, we have not absolutely selected what criteria will be used. For example, one could set high-risk criteria as more than 10 percent of the structures or 15 percent, with elevated levels. We're debating those criteria right now, but it will be a combination of those criteria, and the map will be available later this year.

Senator LAUTENBERG. I wanted to ask you about S. 1697. We require school testing in radon-prone areas. Should that be amended to require testing everywhere as a condition of its being?

Mr. GUIMOND. Well, we have recommended that all schools be tested. I'll give you just a recent example that demonstrators on rationale for this recommendations. We've been continuing our surveys around the country, and Alabama, for example, is a State that overall has a low percentage of homes with elevated levels of radon. I think our housing survey showed that less than 6 percent of the houses were going to have high levels of radon in the houses, but we did in northern Alabama find some houses at nearly 200 picocuries per liter.

Similarly, with some testing we're doing in schools there now, we have found a school facility in northern Alabama with levels in excess of 300 picocuries per liter. So, unfortunately, just identifying high risk areas alone is not going to take care of every school.

Senator LAUTENBERG At this point, I'll turn to my colleague.

Senator BAUCUS. I just have a couple questions. Thank you, Mr. Chairman.

Gentlemen, as we all know, children tend to be at higher risk than adults, and I'm wondering if the standard for schools and for children should be a lower standard, that is, lower than four picocuries per liter, which is the otherwise general standard? Should it be a tougher standard for children because of higher risk?

Mr. GUIMOND. Let me address it from our standpoint. The guideline of four picocuries per liter that has been established was based on technical capabilities. That's about as low as we thought we could get with mitigation technology at that time.

We used the same value for schools because we had similar kinds of information. We're currently in the process of evaluating the guideline for housing and will consider it for schools also, because the Indoor Radon Abatement Act asked us to re-evaluate that.

I think one thing that you have to keep in mind that you want to keep the levels as low as you generally can to reduce total exposure. I think using a guideline similar to houses is reasonable, but we want to take a look at what the costs are to reduce schools to this level, and make sure we're as cost effective as possible.

Senator BAUCUS. I asked the question because, as we know, children's respiratory function is much more rapid.

Mr. GUIMOND. Of course, they're spending less time in the schools——

Senator BAUCUS. Sorry?

Mr. GUIMOND. They are spending less time in a school than they would in a house. Overall risk which is based on exposure is a combination of the amount of time you spend in a building, both in number of hours per day as well as number of years overall, and so we factor those things in as we look at establishing values.

Dr. HOUK. Mr. Baucus, the action level of EPA is not based upon risk. It is based upon what technology is available to get down to that level. As I said, at that level the risk of a lifetime exposure is about a 40 percent increase. Certainly, as the technology improves, we're getting below those levels. The risks will be lowered.

Senator BAUCUS. Okay, thank you.

I have no further questions. Thank you, Mr. Chairman.

Mr. Guimond, can you provide us with an estimate of the cost of implementing S. 1697?

Mr. GUIMOND. Yes, we can do that. We require some assumptions at this point in time. Let me give you a couple of benchmarks on those costs. If you were to assume that all schools in the country were tested, just to give you one idea the cost, that would cost somewhere on the order of $50 million to $100 million to test all schools in America. There are a little over 100,000 schools.

If the same percentage of schools were found to have high levels as we are finding in houses. About 10 percent or so of using costs of on the order of $5,000 to $15,000 to fix a school, we would get costs on the order of $50 million to $150 million to fix throughout the country.

If you take a look at the finding in your current bill, that would test perhaps 10 percent of the schools in America and fix high levels found in all of those schools. Now, exactly how many schools are in high risk is going to be somewhere between there.

Senator LAUTENBERG. Should we require that testers approved under the EPA Proficiency Program or a similar State program conduct any testing, or can school employees carry out the testing?

Mr. GUIMOND. I think school employees can carry out testing if they have been trained and if they are using devices and equipment that has been approved through the Radon Measurement Proficiency Program.

Senator LAUTENBERG. How do we know if they've been trained?

Mr. GUIMOND. Well, you would have the State indicate that they have adequately trained the people in those schools. Otherwise, it would be much better to have the trained people in the private sector doing it.

Senator LAUTENBERG. If there is a proficiency test of any type for the professionals, I would assume that we can use something similar for school employees, again, if it's confirmed that they have been through the cycle.

In testimony submitted for the record, GAO states that EPA's Radon Measurement Proficiency Program does not require radon measurement companies to implement quality assurance programs. Without such requirements, how can EPA and the public be sure that the measurement results they obtain are accurate?

Mr. GUIMOND. We have gotten the review from the GAO, and we had already performed a review of our own with our Science Advisory Board, and we are making a number of enhancements and improvements to the Radon Measurement Proficiency Program.

One of the improvements is a stronger reliance on quality assurance, that is, maintaining more quality assurance by the individual testing companies and a stronger quality assurance program at EPA. Those improvements are underway.

Senator LAUTENBERG. As everyone is aware, we have concerns about asbestos as well in schools. Can you foresee where a radon mitigation program might create an asbestos problem in the school?

Dr. HOUK. I don't see any, and I would like to voice my personal view, Mr. Lautenberg, that the risk of non-friable asbestos in buildings, people working for 30 years, the relative risk is 1.002. The risk of radon in the same situation is 1.4. Also, some of us are con-

cerned that removal of asbestos is creating more risk than it's mitigating.

Senator LAUTENBERG. Is that your view?

Dr. HOUK. Yes, it's my view, and it's several other people's view also, but that is not a problem with radon. I cannot see any situation where radon would disturb asbestos that is in the school as it already exists.

Mr. GUIMOND. If I just might comment on that, too, generally, I think taking care of a radon problem is not going to aggravate any type of asbestos-related problem in a school. In fact, I think we will find that fixing a radon problem in a school is probably going to help the overall air quality in a school. Let me give you one illustration. In many schools that have the higher levels, we find that that problem is due not only to a lot of radon in the ground underneath the building, but the fact that the air handling system is operating poorly in the school. They have the intakes closed down or they have too many exhaust fans. By rebalancing the air handling system you get dramatic improvements in air quality as well as radon reduction.

Senator LAUTENBERG. We'll close with this last question.

Mr. Guimond, the bill requires testing in radon-prone areas. EPA has urged schools everywhere to test. If schools are testing, S. 1697 will not have much of an effect. If schools are not testing, however, S. 1697 will require schools to conduct this testing you recommend. So how can the EPA oppose this bill?

Mr. GUIMOND. Well, we would prefer at this point in time to continue the non-regulatory approach to work with the States and have them in turn work with the school districts so they in fact can get the testing done in a reasonable time frame. We clearly want the testing done, but we believe that it can happen through a non-regulatory program.

Senator LAUTENBERG. That comes through with a very mixed message.

Dr. Houk?

Dr. HOUK. Senator, I would like to support the extension of testing every school unless it's absolutely demonstrated that there is no problem in that particular area. My own home in Atlanta I have tested, and I do not have any radon in it. The house 20 feet from me has about 16 picocuries per liter in the thing, so you can't use your neighbor's thing.

I'd like to also say, if I could, that much of our mandatory inspections, i.e. termites, is done for the protection of the financial institutions that hold the mortgages. Isn't it about time we started testing for the protection of our children who live and inhabit these places? Thank you.

Senator LAUTENBERG. With that, we conclude this section of the hearing, and we'll adjourn for 10 minutes while I go do my duty and vote, and we'll then hear from the next panel.

Thank you both very much for being with us.

[Recess.]

Senator LAUTENBERG. We welcome our three witnesses. Dr. Jill Lipoti, I note, was sitting in the back and shaking her head whenever she and I agreed on the right side of things. Nice to see you. Dr. Lipoti is the Assistant Director, Division of Environmental

Quality, from, of all places, the New Jersey Department of Environmental Protection. We welcome you.

Mr. Harvey Press is President of NEA of Rhode Island, and Dr. DiLiberti, who is from the Committee on Environmental Hazards from the American Academy of Pediatrics. We're pleased to see you.

I know that Senator Chafee wanted to be here to personally welcome you, Mr. Press, but unfortunately he's detained on something of relative urgency, and he sends along his apologies and his greetings.

We're pleased to have you here. All three of you had a chance to listen to the other testimony, I'm sure some of which you would agree with and perhaps not have much disagreement, but we're anxious to hear what you have to say.

We're going to put on a five-minute timer and ask you to summarize your statement within that time. The full statements that you have will be included in the record.

We'll start by hearing from Dr. Lipoti. Welcome.

STATEMENT OF DR. JILL LIPOTI, ASSISTANT DIRECTOR, DIVISION OF ENVIRONMENTAL QUALITY, NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

Dr. LIPOTI. Thank you, Chairman Lautenberg. I appreciate the opportunity to comment on the pending Senate legislation S. 1697, which would require each local educational agency to test each school building.

The New Jersey Department of Environmental Protection supports this legislation and lauds the efforts of Congress to address this issue. I would like to address two issues in my comments: one, some New Jersey data on radon levels in schools, and, two, comments on the proposed legislation.

Senator LAUTENBERG. You may have to bring that mike just a shade closer.

Dr. LIPOTI. Staff in the New Jersey DEP radon program recently prepared a paper for EPA's 1990 international symposium on radon and radon reduction technology which addressed radon levels in non-residential buildings in New Jersey. I've attached a copy of that paper that was done by my staff members, Karen Tucillo and Nick DePierro.

This paper presented information collected through the DEP's Confirmatory Testing Program from January 1986 through August of 1989. Among the information collected was radon testing data from 69 schools located in 11 counties. The radon levels ranged from 0.1 to 95 picocuries per liter, with an average radon concentration of 3.94 picocuries per liter.

Three out of the 11 counties indicated average school radon concentrations of greater than four picocuries per liter, and, in addition, 10 of the counties had at least one school radon reading exceeding four picocuries per liter.

The paper also included information on other non-residential buildings, such as hospitals, municipal buildings, churches, and professional buildings. Of the 637 radon measurements collected in

141 buildings throughout the State, 37 percent exceeded four picocuries per liter, and over 4 percent exceeded 20 picocuries per liter.

This work indicates that elevated radon levels do occur in schools and other non-residential structures and that it is widespread in the test areas of the State.

Now, concerning the legislation before this subcommittee, this bill, in overview, contains many worthy points. In particular, the condition to limit the mandatory testing to areas identified as having elevated levels of radon within a State; the decision to test all types of schools, private and public; the notification of results process; the decision not to mandate remediation but rather to allow local educational agencies to decide that issue; and the allocation of funds to assist local educational agencies in testing and, if necessary, remediating school buildings for radon are commendable.

There is, however, one area that's not addressed in the legislation which I believe would be a positive addition. The legislation does not address the issue of what happens to a school which may have already tested for radon, a "grandfather clause".

This situation might be quite prevalent in the northeast section of the United States and in Florida. It's difficult to suggest draft language for this type of clause due to the diversity and maturity of radon programs throughout the United States; however, we have attempted to put together some language.

Schools which have tested a building prior to the establishment of this act and have conducted the test in accordance with any guidelines established by the Administrator shall not be required to retest a building. Such schools shall submit a report to the Administrator which outlines the outcome of the test results.

Senator LAUTENBERG. That's probably not a bad idea.

Dr. LIPOTI. Possibly one area that could be improved in the existing legislation is the financial assistance process. Schools should be encouraged to test and remediate on a timely basis. The ranking and review processes outlined in section 4(b) et seq. might lead to a delay in testing and remediation until the outcome of the request is known by the local educational agency, and there might be an additional delay while the district seeks alternate methods of financing.

The goal of the legislation might be better served through a reimbursement plan for needy educational agencies rather than through a loan grant program. There are, of course, pros and cons to this type of plan. Appropriations would not go as far as they would in a loan program, and they would probably only go to the most needy educational agencies.

But this type of plan would seem to better serve the intent of the legislation, which is to reduce individuals' exposure to radon in school buildings on a timely basis.

Once again, thank you for the opportunity to address the subcommittee and comment on pending legislation S. 1697. If you have any comments, I'll be glad to address them.

Senator LAUTENBERG. Thank you very much.

Now we'll hear from Mr. Press, and the five-minute rule is the same.

STATEMENT OF HARVEY B. PRESS, PRESIDENT, NATIONAL EDUCATION ASSOCIATION OF RHODE ISLAND

Mr. PRESS. Thank you, Mr. Chairman. My name is Harvey Press, I'm the President of NEA Rhode Island. I'm a classroom teacher, I taught 21 years of the sixth grade, and, needless to say, this is a great honor for me to be here testifying before the U.S. Senate subcommittee.

I appreciate the opportunity to speak on behalf of the NEA and the National PTA Associations (PTA). Teachers and parents are deeply concerned about the hazards of radon in the schools. EPA estimates that 20,000 lung cancer deaths a year are attributable to radon exposure. Only cigarettes cause more.

Tragically, children, because their metabolism is much more rapid and they inhale more often than adults, are more at risk than adults. Exposure to radon during the first 10 years of life represents one-third of the lifetime risk of exposure.

Ample evidence shows that school buildings frequently have high levels of radon, especially those that have taken steps to enhance energy efficiency and those in certain geographical areas.

In 1989, EPA tested radon levels in 130 schools in 16 States. Almost 20 percent of the 3,000 schoolrooms tested had radon levels above the action guideline, and 3 percent had radon levels five times greater than the action level. Another survey of 140 Pennsylvania schools found 43 buildings with elevated radon levels. A New Jersey study found elevated radon levels in half of the 41 school buildings tested.

Testing for radon is relatively easy and inexpensive. In contrast to testing for hazardous asbestos, radon testing can be carried out by school personnel using methods approved by EPA. In the same way, mitigation techniques for reducing radon levels are straightforward and can often be performed by school personnel or original contractors.

NEA and PTA have long worked to eliminate environmental health hazards in public schools. In the previous Congress, we supported the Indoor Radon Abatement Act, which authorized $10 million a year for grants and technical assistance to States for radon testing and mitigation.

In fiscal year 1990, Congress appropriated $1 million for a national survey of schools, scheduled for release in 1992. We strongly support the Radon Testing for Safe Schools Act. This legislation would authorize $5 million for radon testing in the schools and $5 million per year between 1992 and 1996 to assist schools with radon mitigation costs.

This bill is reasonable and prudent and in financial terms a modest approach to a serious health hazard. Using current and forthcoming EPA data, the bill would require radon testing in schools in geographic areas identified as having elevated levels of radon. Moreover, this legislation would provide financial assistance to schools for radon testing and mitigation. Applications would be evaluated based on the financial need of the school and the nature and magnitude of the potential exposure to radon.

The bill's grant and loan program is essential. In fact, we support increasing the authorization for the testing program from $5

million to $10 million. Many schools face severe economic difficulties in meeting competing needs. As one example, capital outlays by U.S. public schools increased by more than 12.6 percent between 1987 and 1988 and 1988 and 1989.

We recommend that the bill be amended to require schools with levels above 20 picocuries per liter to take corrective action, and I'll repeat that. We recommend that the bill be amended to require schools with levels above 20 take corrective action. Those with levels between four and 20 picocuries per liter should be required to conduct further tests.

In addition, we believe current radon testing and mitigating procedures must be evaluated periodically. As better mitigation methods are devised, the current action guideline of four picocuries per liter should be lowered.

We appreciate your leadership, Mr. Chairman, and the work of Senator Chafee and others on the subcommittee in efforts to eradicate environmental hazards in the classroom. We ask that you continue to inform Americans about the hazards of exposure to radon and increase efforts to provide resources and technical assistance to eliminate this danger from American schools. Thank you.

Senator LAUTENBERG. Thank you very much, Mr. Press.

Dr. DiLiberti, what's the pin that you're wearing?

Dr. DILIBERTI. "Speak up for children."

Senator LAUTENBERG. I see. Well, that's appropriate for a pediatrician, I'd say. We're glad to have you with us and invite you also to give us your summary testimony, and your full testimony will be included in the record.

STATEMENT OF DR. JOHN H. DiLIBERTI, COMMITTEE ON ENVIRONMENTAL HAZARDS, AMERICAN ACADEMY OF PEDIATRICS

Dr. DILIBERTI. Mr. Chairman, members of the committee, and staff, I am John DiLiberti, a member of the Committee on Environmental Hazards of the American Academy of Pediatrics, and testify today on behalf of the academy.

In addition, I am Director of Pediatrics at Saint Francis Hospital and Medical Center in Hartford, Connecticut, and Professor and Associate Chairman of the Department of Pediatrics at the University of Connecticut Health Center. I appreciate this opportunity to speak today in favor of Senate bill 1697.

Although we are here today to talk about the risks of radon in indoor air, our earliest knowledge of radon risks comes from the unfortunate exposure of uranium miners in Colorado and Europe. By the 1950s, miners who had many years of exposure were experiencing extraordinarily high lung cancer risks, with workers in one European mine having a 50 percent death rate from lung cancer.

Despite this long history of occupational exposure risks, an appreciate for dangers of indoor radon has surfaced only in the past five to 10 years. The 1984 experience of an engineer setting off an alarm in the Limerick, Pennsylvania, nuclear power plant as a result of home exposure is credited as the event which raised national consciousness on this issue.

Radon formed in the ground enters buildings through cracks in foundations, openings for water pipes, and other entry points. It re-

mains until it disintegrates or is removed or diluted by ventilation. Simplistically, radon levels are related to the radon production rate in the underlying soil and rock. The rate of entry is influenced by the type of building construction and deterioration, the rate of air exchange and dilution.

The four picocuries guideline corresponds to a concentration of about one part of radon for every million trillion parts of air. Nationwide, perhaps 20 to 40 percent of homes and schools have one or more rooms which exceed the guideline.

We have heard about radon problems in New Jersey, my former home State, my birth State, and other States. In Connecticut, the Department of Health Services has identified a school which had a room with a level of over 50. Since the vast majority of available data on the induction of lung cancer is derived from exposed miners, the health effects of radon on children must of necessity be extrapolated from this adult information.

The EPA estimate of 5,000 to 20,000 lung cancer deaths due to indoor radon exposure is based on very conservative assumptions. A comparison with other radon standards and exposures is sobering. A child who spends seven hours each day for 180 days each year in a classroom at the four picocuries level will receive a radiation dose many times higher than the maximum allowable exposure from nuclear reactors or waste disposal sites.

This school exposure is also twice the maximum exposure to residents in the vicinity of the Three Mile Island nuclear accident and over 100 times the average exposure. Thus, this target level does not appear to be stringent when compared with other radiation standards.

A universally taught maxim of children's health care in medical schools is children are not little adults, the message being that taking adult parameters and scaling downward by body size will not give numbers relevant to children.

The marvelous nature of growth and development in children typically is associated with processes which occur at very different rates from adults. This leads to several concerns. First, as Dr. Houk pointed out, children are at special risk because of the physiologic processes such as higher breathing rates. Second, they may be exposed to disproportionately greater amounts.

Since children both breathe faster than adults and appear to be more sensitive to the carcinogenic effect of ionizing radiation, based on the atomic bomb survivors in Japan, the risk of lung cancer from a given radon level may be higher in children than adults, increasing the urgency of our response to this hazard.

The American Academy of Pediatrics encourages passage of this bill in order to protect our children from unacceptably high risks of lung cancer. We do, however, have two concerns: first, that we must be certain that a sufficient number of competent contractors is available to carry out the necessary work involved, and, second, that the meaning of "an area identified as having elevated levels of radon" on lines 4 and 5 in section 2(a) is vague.

Newly constructed schools with well-maintained ventilation systems may have low classroom radon levels despite high production rates in the underlying geologic structures. Conversely, poorly maintained older schools may have unacceptably high radon levels

despite locations in geographic areas with inherently lower production rates.

The goal of this legislation ought to be to identify and remediate on a priority basis the school classrooms with the highest radon levels. Poor inner-city schools could perhaps be less likely to receive attention if the current wording is kept.

We suggest rephrasing the section to include the known risk factors for elevated classroom radon levels which go beyond the single geographic factor implied in the current wording. Thank you for the opportunity to present our views on this important subject.

Senator LAUTENBERG. Thank you very much, Dr. DiLiberti.

I think we're going to go in the Guinness Book of Records. All three panelists finished before the light went red, and I don't think that's ever happened here. We thank you very much for your very thoughtful and very positive testimony.

The only thing I would ask you, Dr. DiLiberti, how could you leave New Jersey once having started there?

We meet so many people who say, I used to live in New Jersey. Used to—I don't like to hear that, but then on the other hand we take pride in the fact that we have created a very energetic, very vibrant population and they migrate, giving the benefit of their intellect and their accomplishments around the country. We're happy to have you with us.

Dr. DILIBERTI. Most of my family still lives there. We had a family reunion a few years back, and 127 descendants of my grandfather showed up in Secaucus.

Senator LAUTENBERG. Wow. Is that right? Where was this?

Dr. DILIBERTI. Secaucus, New Jersey.

Senator LAUTENBERG. Where is your family from? Where are you from originally?

Dr. DILIBERTI. I was born in Jersey City, grew up in Secaucus and New Milford.

Senator LAUTENBERG. Is that right? That's interesting. Anyway, we're happy to have you here. I get very nostalgic about New Jersey, especially when I'm overexposed to the contaminants here for too long.

The subject we're considering today is a very serious one, and I would ask both Dr. Lipoti and Dr. DiLiberti how you would characterize the evidence concerning the health threat posed by radon compared to other environmental contaminants which we control? It's the same question I put to the other panel, and I'd appreciate your response.

Dr. Lipoti.

Dr. LIPOTI. Thank you. In New Jersey, the Department of Health did an excellent epidemiologic study on this area, and we used some of their health risk estimates to show that somewhere between 160 and 640 lung cancer cases per year occur in New Jersey due to radon, and I think that's an extremely high number.

We compared that to other risks like pesticides, which was less than 50 cases of any sort of cancer, then we went to drinking water, which was around five, living near a hazardous waste site, which was also very, very low, and radon comes out as the worst environmental health risk under all of the studies.

Senator LAUTENBERG. How did it compare to asbestos, let's say? In New Jersey, we've had a sad experience with asbestos, particularly asbestos manufacturing.

Dr. LIPOTI. I think that the difference between asbestos and radon in New Jersey is due to exposure. Asbestos is a limited exposure to individuals, whereas radon is just so widespread in our State.

Senator LAUTENBERG. Dr. DiLiberti.

Dr. DILIBERTI. I would agree, basically. The data on radon is incontrovertible. It's a serious problem, and I think the assessment of that problem is really based on very hard science. Compared to other risks, I guess, as far as children go, we'd have to be very concerned about lead and air pollution as problems that have an immediate impact on the child and don't have the latency of radon, but certainly in terms of carcinogenicity, we think radon is right at the top.

Senator LAUTENBERG. The threat to children is one of particular concern.

Out of the number of cases that you just cited that indicated a linkage between radon and lung cancer, do you know how many of those were exposed as children or in what location? Has the study been that refined?

Dr. LIPOTI. Not, it has not.

Senator LAUTENBERG. We talked earlier to the other panel about this commentary in Lancet that associated radon with leukemia and other cancers.

Dr. DiLiberti, do you have any comments?

Dr. DILIBERTI. Well, as Dr. Houk said, I think it's very preliminary. As they pointed out, there are theoretical mechanisms. We do know that other gases similar to radon can be carried by the blood stream, so I think it's theoretically possible, but I agree that in terms of the kind of proof we'd like to see from an epidemiologic basis it's very preliminary.

Senator LAUTENBERG. You're familiar with the study we're talking about. Is it a credible study?

Dr. LIPOTI. Well, it's a credible study, but it's very preliminary. We need to do a lot more work.

Senator LAUTENBERG. On the school testing issue, Mr. Press or Dr. Lipoti, is there evidence that most schools are testing for radon at this juncture?

Mr. PRESS. I can only speak for a very specific area, which is Rhode Island. Right now, almost all the schools have done some sort of preliminary testing. Our problem with it is the results have been sent right back to the schools, so we don't really have anything that's coming back at a State level to even identify the fact.

The building I was in had a very low rate. It was a fairly new building, it had no basement, but it had a slab for the bottom floor, a one-floor school. There are other buildings that are much older than that, but without knowing and going into those school districts, the only advantage we had was that we had a requirement to post hazardous substance type situation, and most schools interpreted that fairly liberally and when they got the results back posted them in the buildings, and we did not have an outcry, but I would tend to bet it's because nobody knew what the numbers that

you should be looking for. Let me tell you that my eyes and ears have been opened through the testimony this morning.

Senator LAUTENBERG. One of the hardest things to do is to make people realize that this risk is out there. We still have people who smoke, and I don't know whether you're aware of the fact that I'm the author of the legislation that bans smoking in airplanes and reduces it in trains, and yet people continue to smoke despite the threat, except most smokers that I know do it feeling very guilty and embarrassed by their addiction and talk about how hard they're trying to shake it.

In this case, in the case of radon, the alarm is not sufficient out there. People just don't take it seriously enough. Dr. Lipoti, do you think that most schools actually are testing for radon?

Dr. LIPOTI. I don't think that every school has tested, despite the fact that in New Jersey, the DEP and the Department of Health sent out a joint letter to every school district and every municipal government telling them about the hazards of radon and asking them to test their non-residential structures.

Senator LAUTENBERG. It's just not happening. Well, should we amend S. 1697 to require testing everywhere as recommended by EPA? Any response?

Dr. DILIBERTI. I think that's reasonable. In Connecticut, we've had some testing, the State Department of Health Services would like to see every school tested, but their impression off the record, I guess, is that school administrators are nervous about radon following on the heels of asbestos and that they have probably magnified the potential costs involved in radon abatement.

Senator LAUTENBERG. We heard the testimony this morning that said relatively speaking it's a paltry sum.

What do you say, Dr. Lipoti?

Dr. LIPOTI. Well, I think in New Jersey we've done much study that has resulted in tier maps that pinpoint where the radon hazard is the greatest, and we really could just test those schools in tier one and tier two and do an excellent job of finding the problem.

Senator LAUTENBERG. So do you think we ought to require testing at levels that are considered to be significantly risky, that we should get on with requiring testing?

Dr. LIPOTI. Yes.

Senator LAUTENBERG. New Jersey now doesn't require its schools to test for radon.

Dr. LIPOTI. We do not.

Senator LAUTENBERG. Should we require that testers—and I know there was testimony about non-professional agencies doing the testing. Was it your testimony Mr. Press?

Mr. PRESS. We're concerned that there be some regulation.

Senator LAUTENBERG. But do you think that school employees can carry out the testing? I don't know whether any of you feels particularly qualified to comment on that.

Dr. Lipoti, you probably have the most exposure. Can we rely on school employees to be sufficiently trained and instructed on how to conduct these tests that we can rely on them?

Dr. LIPOTI. I believe we can. We, of course, in New Jersey have a certification program for testers and mitigators, so I think that we're a little bit ahead.

Senator LAUTENBERG. Do you concur with the mitigation process and the relative simplicity of it as developed by the earlier panel? It's not really a major problem. Again, costs are costs, and you can't ignore the facts, but it's not tough or impossible in any way to mitigate?

Dr. LIPOTI. It's not difficult to mitigate, and in the paper that is appended to my testimony, we give a range of costs for mitigation of non-residential buildings.

Senator LAUTENBERG. Just repeat it.

Dr. LIPOTI. From $100 to $30,000.

Dr. DILIBERTI. I would respond that we're at a point where if we don't do something the costs may be much more later on. I think based on the testimony I've heard this morning and I think the evidence is building up so quickly, I wouldn't call it criminal, but the neglect of not doing something becomes a serious thought for those of us who are working with children that if we now know there is such a hazard, and we're not investigating to see whether we have that problem, and then because of the cost of asbestos, we use that as a reason not to do this, I think we've got some serious problems.

Senator LAUTENBERG. Well, what's happened is we've got the learning process that deals with asbestos, concern about drinking water, as you heard if you were here earlier, storage tank problems, hazardous waste sites, there's a lot, and the question is whether the threat posed by radon is serious enough to say, okay, we understand that there are other problems, but this is one you've got to take care of. Is that a view shared by you all?

Dr. LIPOTI. It is extremely serious. It is the most serious environmental risk.

Senator LAUTENBERG. That's the issue. I'll ask once again a question I asked earlier. The question of asbestos in schools is one that is under constant review, and I visited a school in Newark the other day, a diocesan school up there—we don't want children exposed to danger, whether it's in a parochial school or in a public school—where the asbestos is fairly firm, not migrating through the air, it looks like the air is relatively de minimis. Do we stir up anything, with your awareness of the mitigation problem, by getting on to dealing with the radon problem?

Dr. LIPOTI. No, I would concur with Richard Guimond's earlier statement, that by increasing the ventilation flow, we would decrease a lot of indoor air problems, if that was the mitigation method so chosen.

Senator LAUTENBERG. Well, we thank you all very much. You were very helpful. Your comments will be reviewed as part of the development of the bill, and with that, we conclude this hearing.

[Whereupon, at 11:45 a.m., the subcommittee was adjourned, to reconvene at the call of the chair.]

[Statements submitted for the record and the bill S. 1697 follow:]

TESTIMONY BEFORE THE SUBCOMMITTEE ON SUPERFUND,
OCEAN AND WATER PROTECTION
SENATE COMMITTEE ON THE ENVIRONMENT AND PUBLIC WORKS
MAY 23, 1990
HONORABLE BART GORDON (D-TN)

Good morning. First, I would like to thank Senator Lautenberg for introducing the companion version of my legislation, the Radon Testing for Safe Schools Act, and for taking the first opportunity to move ahead with hearings on the bill. Working together, we have incorporated the suggestions of various education and consumer groups and crafted what I believe is an excellent and very much needed piece of legislation.

Radon is one of the indoor air pollutants that poses a special challenge. You can't see it, smell it, or taste it, so it can be difficult to persuade people that radon really is dangerous. But radon is a killer, the second leading cause of lung cancer in America responsible for 20,000 deaths a year.

These are unnecessary deaths. Testing and mitigation for radon is relatively easy and inexpensive. Our challenge is to encourage this testing and mitigation both in homes and in schools.

My own concern about the radon problem comes from the high levels of radon in Tennessee. Radon, created by the natural process of decay in uranium, occurs all over the country. But certain geologic formations, such as the Chatanooga shale which we have in Middle Tennessee, increase the concentration of radon. Early EPA studies of radon levels in homes showed that we have a real radon problem in Tennessee.

Senator Lautenberg has led the legislative effort to ensure

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that homeowners who undertake radon reduction programs qualify for a medical expense tax deduction. I have introduced the companion bill on the House side. So far procedural roadblocks have narrowly prevented this clarification of the tax code from being included in budget reconciliation language. But we will keep trying because it is important to encourage homeowners to reduce their risks of radon contamination.

I believe we have an even greater responsibility to reduce radon levels in schools. Children, because of their small lung capacity and their higher respitory rates, are particularly susceptible to radon contamination.

Following enactment of the Indoor Radon Abatement Act last Congress, EPA conducted sample tests of radon levels in 130 schools in 16 states across the country. EPA's testing and mitigation projects in Tennesee prove instructive, I believe, for the national problem.

In the EPA survey, several schools in the Nashville area registered the highest rates in the country -- shockingly high counts of 149, 124, and 136 picocuries. Let me put that in perspective. EPA's "action level" -- the level above which radon becomes especially dangerous -- is 4 picocuries. At 4 picocuries, you are being exposed to the equivalent of having about 200 X-rays a year. The national goal is to reduce indoor radon to the same concentration of radon which exists in ambient air, about .2 to .7 picocuries. Clearly, Middle Tennessee schools have a serious radon problem.

But Tennessee is not alone. EPA reported that over half of the 130 schools tested had at least one radon measurement over 4 picocuries, and 20% of all the classooms tested had radon over this 4 picocurie action level. Schools from Washington to New Jersey,

Maine to Georgia, Montanna to New Mexico, and Minnesotta to Illinois have high radon concentrations.

I am very much aware of the problems which school administrators face today. And I am sympathetic. We have asked local education agencies to be responsible for meeting an ever increasing list of federal environmental mandates. First it was asbestos, then lead in drinking water, now we are talking about radon. I know the horror stories surrounding AHERA and, believe me, the purpose of this bill is definitely NOT to create another bureaucratic nightmare for school administrators.

But the facts about radon are clear. A recent large-scale epidemiological study conducted in New Jersey provided real-life proof of the connection between radon and lung cancer. It showed that women exposed to high radon levels increased their risk of lung cancer by as much as 40%. And children are more vulnerable than adults. It is simply unacceptable to expose children and their educators to dangerous radon levels when remedies are so easily available.

School administrators, naturally, are concerned about costs. But we need to consider more than just today's costs. We have to look at the bill that will come due in ten or twenty years. In addition to the human suffering that accompanies lung cancer, there are significant economic costs. The American Lung Association estimates that the total economic cost of respitory cancer was over $11 billion in 1988, and radon is the second leading cause of lung cancer. Compare this figure to the minimal costs of radon testing and mitigation, and the value of prevention becomes clear. Radon testing and mitigation saves lives and dollars.

The Radon Testing for Safe Schools Act, H.R. 3370, is based on this concept -- that prevention is good public policy. a simple

premise. That premise is that parents have a right to know if their children are being exposed to high radon levels. Teachers have a right to know their own risks. So do school employees.

The only way to find out about radon levels is to test, and the bill does mandate testing. But not all areas in the country have a radon problem. Accordingly, H.R. 3370 requires that schools in EPA-designated "hot spots" test for radon and that schools make those results public to parents, teachers, and school employees.

Testing is not complicated. Nor is it expensive. Most tests involve only charcoal canisters which cost about $10 each. EPA recently released a publication entitled "Radon Reduction Techniques in Schools" which provides LEAs with a step by step guidance in testing. To avoid problems created by questionable equipment or firms, H.R. 3370 requires that schools use EPA or state approved radon testing firms.

We recognize that not all schools can afford the costs of even basic testing. So, H.R. 3370 establishes a grant/loan program to help needy schools pay for mandated testing and any subsequent voluntary mitigation programs. The bill does not mandate mitigation.

Reducing radon levels often is a simple task. Mitigation can be as easy as caulking windows and sealing cracks to installing added ventilation fans. Mitigation costs also are relatively inexpensive. Let me give you an example.

The Two Rivers Middle School and Glenview Elementary School in Nashville had some of the highest radon levels in the country. With the EPA's help we reduced these classroom radon levels down from a high of 136 picocuries to an average of less than 2 picocures. The total cost was about $25,000. That covered both schools and included testing, construction work, and salaries. And here, I would like to thank the EPA for all of their work in tackling what

was a difficult radon problem in Middle Tennessee.

Knowing that these costs can be a problems for some schools, H.R. 3370 does provide loan/grant funds for help in paying for radon mitigation costs. The testing and mitigation loan/grant programs will be administered by a new Radon Testing and Mitigation Assistance Program in the new Department of Environmental Affairs. Available funding includes up to a 100% loan, a 50% grant, or a grant/loan combination. LEAs will apply for assistance through the states with awards determined by their governor's recommendations, the extent of the radon problem, and financial need. H.R. 3370 authorizes a six year program of testing and mitigation assistance totalling $30 million over a five year period.

Mr. Chairman, H.R. 3370 and S. 1697 have bipartisan support in the House and Senate. The measure has been endorsed by the NEA, the PTA, the American Academy of Pediatrics, the American Lung Association, the Consumer Federation of America, and the Coalition for Consumer Health and Safety. I want to express my appreciation to all of these organizations for their suggestions and support on this important legislation.

On the House side, Chairman Waxman has committed to holding hearings on H.R. 3370 this summer in the Health & Environment Subcommittee of the Energy & Commerce Committee. I am very encouraged about the prospects for passage and, again, want to thank you for your efforts to enact the Radon Testing for Safe Schools Act.

Cosponsors of HR 3370:

Cooper, Dorgan, Jontz, Boxer, Clement, Beuchner, Foglietta, Collins, Lewis (GA), Robison, Owens (NY), Eckart, Hawkins, Kennedy, Dellums, Johnson (SD)

Cosponsors of S 1697:

Chafee, Bradley, Moynihan, Lieberman, Conrad, Heinz, Pell, Dodd.

RADON TESTING FOR SAFE SCHOOLS ACT

HR 3370 CONGRESSMAN BART GORDON (D-TN)
S 1697 SENATOR FRANK LAUTENBERG (D-NJ)

SUMMARY:

1. Requires all schools in EPA designated radon "hot spots" to test for radon.
2. Requires that the results of these tests be available to the public and be provided to parent, teacher, and school employee organizations.
3. Requires that testing and any mitigation for radon must be conducted by a firm or individual approved by the EPA or a state radon proficiency program.
4. Establishes a loan/grant assistance program in EPA to provide needy LEAs with a 100% loan or 50% grant to cover the costs of radon testing or mitigation.
5. Establishes within EPA a new Radon Testing and Mitigation Assistance Program to administer the loan/grant program.
6. Requires LEAs to submit applications to state governors who will establish a priorty list based on the extent of the radon problem. EPA will provide assistance based on the governor's recommendations, the extent of the radon contamination, and financial need of the applicant.
7. Requires EPA to provide Congress with annual reports to track the radon testing/mitigation assistance program and estimate the number of schools located in non high-risk areas which still are in need of radon testing and/or mitigation programs.
8. Authorizes $30 million through 1996 for these programs.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333

FOR RELEASE ONLY UPON DELIVERY

Testimony by

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Public Health Service
Department of Health and Human Services

on

Indoor Radon

Before the

Subcommittee on Superfund, Ocean,
and Water Protection
Committee on Environment and Public Works
U.S. Senate

May 23, 1990

Good morning, Mr. Chairman. I am Dr. Vernon N. Houk, Director, Center for Environmental Health and Injury Control (CEHIC), Centers for Disease Control (CDC), Public Health Service (PHS) and I am pleased to testify on behalf of the Department of Health and Human Services on the subject of indoor radon. We are providing detailed testimony because of the scientific complexity of the radon issue and the uncertainty in the public about the potential health risks of exposure to radon.

In December 1984, radiation detection devices at the Limerick Nuclear Power plant in Pottstown, Pennsylvania detected abnormally high radiation levels each time a particular construction worker entered the plant construction site from his home. An investigation to determine how and where this worker was being contaminated with radioactive material found that the air in the man's home contained extremely high levels of radon decay products. For each year the worker and his family lived in the home they were exposed to over 50 times the annual occupational limit of exposure to uranium miners. The radon concentrations found in this home and others in the geological region known as the Reading Prong surprised even those of us who were already aware of and concerned about the indoor radon problem. The publicity surrounding these homes allowed us to bring the risk of indoor radon to the attention of policy makers and the public.

Radon is an inert gas that results from the radioactive decay of radium. Both radium and radon are products of the decay of uranium to lead and occur wherever natural uranium deposits exist. Radon decays into

radioactive atoms of polonium, bismuth, and lead which attach to airborne particles such as dust or cigarette smoke or remain unattached as electrically charged ions. If these decay products, called radon progeny or daughters, are inhaled, they can deposit along the trachea and within the lungs. The units used to measure radon progeny concentrations and exposure were developed for use in underground mines and are consequently unique. Radon progeny concentrations are expressed in terms of working levels. A Working Level (WL) is any combination of short-lived radon progeny in one liter of air that produces 1.3×10^5 million electron volts (Mev) of potential alpha energy. Exposure to radon progeny over time is quantified as Working Level Months (WLM). To calculate the number of WLM's, the hours of exposure are divided by 170 hours (a working month) then multiplied by the WL (WLM = WL X (hrs exposed/170)). These terms are used because the actual radiation dose to the lung cannot be measured. Using EPA's methodology, 200 picoCuries per liter (pCi/l) of radon gas converts to 1 WL so that the remedial action guide of 4 pCi/l is equivalent to 0.02 WL.

Radon was first identified as an occupational hazard to underground miners. However, our experience in Pennsylvania and in other States clearly demonstrates that miners are not the only persons who may be exposed to elevated levels of radon. In the past, elevated levels of indoor radon were thought to be due primarily to soil contaminated with wastes from mining and milling uranium, radium and phosphate. However, we now know that natural concentrations of uranium and radium which are found in soil and rock throughout the United States are the largest

source of indoor radon. Radon typically enters a building directly from the soil through cracks, such as those in a basement floor, and through openings around pipes and wiring. Water can also be a source of indoor radon if a residence has a water supply with high concentrations of radon. Radon found in drinking water is released readily into the air of a residence during water use. The primary hazard from radon in water is from the inhalation of radon released from the water not from ingesting the water itself.

The carcinogenic power of radon has been demonstrated consistently in both human and animal studies over many years. Excess lung cancer has been reported in numerous studies of lead, zinc, fluorspar, and uranium miners exposed to radon. CDC's National Institute for Occupational Safety and Health (NIOSH) has conducted studies which show an increased risk of lung cancer in both smoking and non-smoking groups of American miners. Animal studies support the relationship between lung cancer and exposure to radon progeny either alone or in combination with cigarette smoke.

Table 1 compares the risk of dying from lung cancer based on studies of uranium miners to the risk from smoking and to occupational exposure to asbestos, arsenic, coke, and chromates. The table provides the relative risk which is the risk in an exposed population divided by the risk in an unexposed population. For example, workers exposed to asbestos have a risk of dying from lung cancer 5 times that of workers not exposed to asbestos based on five studies included in the table.

Table 1

Lung cancer mortality risk of uranium miners compared to the risk from smoking and to occupational exposure to asbestos, arsenic, coke, and chromates

Exposure	Number of studies	Relative risk median	Range for 50% of the observations
uranium mining	5	20.0	14.0 - 23.4
cigarette smoke	27	10.9	4.5 - 15.5
asbestos	5	3.3	2.3 - 5.0
coke	11	2.3	1.7 - 2.5
chromates	14	14.5	3.5 - 35.0

In contrast to the above risks which are based on studies of humans, estimates of the risk to humans from most environmental carcinogens must be extrapolated from studies of animals exposed to high levels of the suspected carcinogenic agent. However, since data is available from underground miners, risk estimates for indoor radon are based on human rather than animal studies. While early studies of miners consisted primarily of populations with cumulative exposures higher than those thought to be possible in the general population, more recent studies show an increase in risk at cumulative exposures that can be attained by

living in a house with elevated radon. A significant increase in risk has been demonstrated at cumulative exposures between 50 and 99 working level months (WLM) in a 1988 study of Czechoslovakian miners. Living in a house at an average level of 0.02 WL for a lifetime would give a total exposure of about 57 WLM. In the Reading Prong area of Pennsylvania, 40% of the homes tested had levels above 0.02 WL and, in about 10% of the homes, residents could accumulate up to 300 WLM over a lifetime. Because an increased risk of developing lung cancer has been demonstrated after cumulative radon exposures of 50 to 100 WLM, extrapolation of the risks calculated from miner data to the general population appears straightforward and justified. In addition, studies of Hiroshima survivors have shown an increase in the risk of lung cancer at doses comparable to a radon exposure of between 10 and 60 WLM.

Because of the magnitude of the potential risk from indoor radon, the U.S. Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission established a National Academy of Sciences (NAS) Committee on the Biological Effects of Ionizing Radiation IV (BEIR IV) to evaluate the risk from radon progeny and other alpha emitters. In 1988, the NAS Committee published a report titled "Health Risks of Radon and other Internally Deposited Alpha-emitters." Unlike previous risk estimates, the BEIR IV estimates were based on the pooled analysis of data from four underground miner cohorts that had originally been studied separately. Data from each cohort were also analyzed individually to verify the consistency of the BEIR IV model.

The BEIR IV Committee as well as other researchers have reviewed the factors that affect the dose to the bronchial epithelium of the lung from radon progeny. Because radon progeny attach to particulates in the air, the radiation dose to the lung depends on the size of the particulates in the air and their concentration, the size and shape of the lung, breathing rate, mucus thickness and factors such as the degree of equilibrium between radon and its progeny. Each of these variables can vary for an individual and/or for various indoor and underground environments. The relationship between these variables and the dose to the lung are not always obvious or direct. For example, the high breathing rate attributed to miners at work may actually lower their radiation dose because particulates deposit less efficiently in the lung at higher rates of inhalation. In addition, the large visible particulates associated with some mines are less respirable and may pose less risk than the fine dust found in homes. After evaluating these types of factors for exposure in mines and in residences, the BEIR IV committee concluded that an exposure of one WLM in a mine is approximately equivalent to one WLM in a home in terms of the radiation dose to the bronchial epithelium of the lung. <u>This is an important consideration in applying risk estimates for miners to the general population exposed to indoor radon</u>.

Because factors such as lung size and breathing rate affect the dose to the lung, the risk from radon exposure should be evaluated separately for children. The health impact of childhood exposure to radon is not readily evident because lung cancer does not appear until decades after exposure. Characteristically, lung cancer does not develop in humans

until after age 35 and more commonly after age 50. In studies of underground miners, the period of time between exposure and the diagnosis of lung cancer has been as long as 50 years with a mean of 20 to 30 years. Because the underground miner studies only include adults, epidemiologic data are not available on the excess lung cancer risk in individuals who were exposed to elevated radon as children. However, the BEIR IV Committee states in their report that exposure before age 20 may carry greater risk than exposure at other ages. Data from the Japanese atomic bomb survivors support this hypothesis. In addition to being more sensitive to the effects of radiation, in general, dosimetric models indicate that children receive a higher radiation dose to their lungs than adults for a given exposure. For example, a child of age 10 years receives 2 times the lung dose than an adult at the same radon concentration. The International Commission on Radiological Protection (ICRP report 50) supports this view and states that individuals exposed under age 20 appear to have a higher risk of developing lung cancer than those exposed later in life.

Smokers should also be considered a spe ial population because of their increased risk from radon. Smoking alone poses a substantial risk of lung cancer and is associated with 106,000 lung cancer deaths each year. Radon exposure appears to multiply this risk. The BEIR IV Committee reported that smokers exposed to radon have at least a 10-fold increased risk compared to that among non-smokers exposed to the same level of radon. While data are not available for individuals exposed to the combination of passive smoke and radon in their home it is likely that the effect on risk would also be multiplicative. Because of the health

risks due to both active and passive smoking and because of the strong interaction between smoking and radon, an anti-smoking message is vital to any public health program on indoor radon. Not only should individuals be encouraged not to smoke, but they should prohibit smoking in their homes.

Tables based on the BEIR IV report showing the risk from radon exposure are included in the testimony. The risk in percent of dying from lung cancer due to lifetime exposure to normal background levels, 0.02 WL and 0.1 WL is included in Table 2. The background risk is included in the risk of lung cancer at the other two levels of exposure. The background risk must be subtracted from the risk at 0.02 WL and 0.1 WL to obtain the risk attributed to radon alone. For example, the excess risk of dying from lung cancer for the general population increases about 40 percent due to lifetime exposure to radon at EPA's recommended level for action of 0.02 WL. We normally express the risk from hazardous substances in the environment in deaths per million people exposed. However, the risk from radon is so large that it is normally expressed in the percent risk of death. This increased risk translates into 14,000 lung cancer deaths for every million people exposed at 0.02 WL.

Table 2
Approximate lifetime risks in percent of Lung Cancer
in the U.S. Population based on BEIR IV

	annual exposure rate		
population	background	0.02 WL	0.1 WL
general population	2.2 - 4.5	3.1 - 6.2	6.7 - 12.3
nonsmokers	0.6 - 1.1	0.9 - 1.6	2.0 - 3.5
smokers	5.8 - 12.3	8.4 - 17.0	17.7 - 32.8

Another way of expressing the risk from indoor radon is provided in Table 3. The relative risk of lung cancer mortality for males and females is given for smokers and non-smokers at various exposure rates. The risks for each group are given relative to persons of the same sex and smoking status. For example, a smoker exposed to 0.026 WL per year has a risk 1.48 times that of a smoker not exposed to radon.

Table 3
Relative Risk[1] of Lung Cancer Mortality for Lifetime Exposure at Varying Rates of Annual Exposure from BEIR IV model

Exposure WL/yr	Males		Females	
	nonsmokers	smokers	nonsmokers	smokers
0	1.0	1.0	1.0	1.0
0.013	1.27	1.24	1.28	1.27
0.026	1.54	1.48	1.57	1.54
0.106	3.15	2.66	3.26	3.04
0.263	6.24	4.24	6.59	5.56

(1) risks relative to persons of same sex and smoking status

The excess risk for selected environmental carcinogens including radon is given in Table 4. Regulatory limits for environmental contaminants are often set at levels with a lifetime risk in the range of 1 in a hundred thousand to 1 in a million. For example, EPA has recommended a 10 pCi/l limit for uranium in drinking water with an estimated lifetime risk of 3×10^{-5}. This means that if 1 million people drink water with 10 pCi/l of uranium throughout their lifetime, 30 would develop fatal cancer as a result. As with radon, uranium is found naturally in the environment. The lung cancer risk from indoor radon at the remedial action level of 0.02 WL is about 100 times higher than the risk considered acceptable from naturally occurring radionuclides regulated by EPA such as uranium and radium.

Table 4
Estimated Excess Risk
Determined from Risk Models

Carcinogen	Excess risk
2,3,8,8-TCDD - 1 ppb lifetime exposure in residential area	0.000001
10 pCi/l uranium in water	0.00003
5 pCi/l ^{226}radium in water	0.000021
1 liter of milk at FDA action level of ^{90}Strontium	0.0000025
0.02 WL lifetime exposure in residence	0.01

Comparing exposures in homes to those in the occupational setting can also provide a perspective on the indoor radon issue. Table 4 compares indoor exposures with the NIOSH recommendations for occupational exposure and the legal limit for exposure for miners set by the Mine Safety and Health Administration. At EPA's remedial action level the exposure rate to the public is almost identical to NIOSH's recommendations for underground miners. If radon were a man-made source of radiation, the limit for exposure would have to be considerably lower than 0.02 WL. Typically the Nuclear Regulatory Commission sets limits for the public for radiation exposure from man-made sources at least a factor of 10 below occupational limits.

Table 5
Comparison of Residential Exposures
to Radon with Occupational Limits

0.004 WL normal background	0.2 WLM/yr
0.02 WL EPA remedial action level	0.8 WLM/yr
limit for miners NIOSH recommendation	1.0 WLM/yr
limit for miners MSHA (under revision)	4.0 WLM/yr

CDC through several of its Centers is involved in gathering health and exposure information on radon, educating the public, and developing recommendations to help limit the exposure to and consequent health effects of radon. In pursuit of these goals, CDC has ongoing interactions with a host of Federal agencies, States, local governments, universities, and the public.

Ongoing collaboration between CDC and the Environmental Protection Agency (EPA) has lead to the development of remedial action guidelines for residences, indoor radon measurement protocols, and the informational pamphlet "A Citizen's Guide to Radon." CDC will be working with EPA on the revision of the "Citizen's Guide" this year and will continue to pursue a coherent radon program not only with EPA, but with other

Federal agencies and States. CDC is an active member of the Radon Workgroup, a sub-committee of the Council on Indoor Air Quality (CIAQ), which coordinates Federal radon policy and includes representatives from agencies interested in any aspect of the indoor radon issue. Over the last five years CDC has provided scientific consultations to States and other agencies on request. Information exchange is also encouraged through personal contacts, meetings and public health conferences. These activities also provide opportunities for interacting with the public as do the numerous letters and telephone calls to which CDC responds.

CDC has a number of collaborative projects with the National Park Service (NPS). While the indoor radon screening survey in NPS residences is nearing completion, CDC continues to provide technical input on matters concerning follow-up measurements, mitigation, and the assessment of the health impact of radon exposure. Because of the concern in the NPS about employee exposure to radon at home and at work, CDC has also been collaborating with the NPS to evaluate radon exposure levels in caves within the national parks. These activities include evaluating cumulative radon exposure of past and current employees, providing guidance on appropriate exposure limits, and providing input on health issues related to radon in caves.

With respect to its own employees, CDC has begun an extensive testing program for indoor radon in its own office and laboratory buildings. CDC has also recommended that employees consider testing their own residences and has provided guidance on screening and follow-up measurement techniques and recommendations for remedial action.

CDC has developed a series of questions about radon for the Behavioral Risk Factor Survey for 1989. The results from this survey can be used to evaluate the level of knowledge and concern about indoor radon in the States which participate in the survey and can assist in planning more effective radon programs. CDC also designed questions for the National Health Interview Survey for 1990. This personal health survey is a national, random sample of the U.S. population and will provide the first national perspective on indoor radon. These questions were designed to evaluate the proportion of the population which is knowledgable about radon, their level of concern, whether they have tested, and whether they have lowered the radon levels in their residences.

NIOSH/CDC participated in the Mine Safety and Health Administration (MSHA) regulatory hearing in August of 1987, and has submitted three documents to MSHA addressing worker exposure to radon progeny in underground mines. The last of these was a criteria document, A Recommended Standard for Occupational Exposure ... Radon Progeny in Underground Mines, which recommended that the current MSHA annual cumulative exposure limit of 4 working level months (WLM) be changed to the lowest feasible limit of 1 WLM. CDC has also made recommendations addressing sampling and analysis strategies, respirator use, and the synergistic effect of smoking, and identified research needs in this area.

The recommendations given above are largely based on the findings of the U.S. Public Health Service study of uranium miners. CDC assumed responsibility for this cohort mortality study and continues to conduct periodic follow-up analyses of the health of this group. The follow-up studies are intended to provide additional information on the nature of the relationship between lung cancer mortality and a combination of smoking and exposure to low levels of radon progeny (below 120 WLM per working lifetime).

CDC considers indoor radon an important environmental health issue. An individual cannot easily control his or her risk from contaminants in the ambient air or in the drinking water. The indoor radon problem is unique because with the right information and encouragement individuals can take action to reduce their own risk and the risk to their families from radon in buildings. Public health agencies have an obligation to provide the public with the information they need to protect themselves. CDC will continue to work towards fulfilling this obligation.

This concludes my testimony. Thank you for this opportunity. I will be happy to answer any questions.

TESTIMONY
RICHARD J. GUIMOND
DIRECTOR, OFFICE OF RADIATION PROGRAMS
OFFICE OF AIR AND RADIATION
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON SUPERFUND, OCEAN AND WATER PROTECTION
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

May 23, 1990

Good Morning. I am pleased to be here today to discuss with you the Environmental Protection Agency's radon program, and specifically the important issue of radon in schools, what is currently known about the problem, and the Agency's efforts to promote radon testing and risk reduction. I appreciate the Committee's long-standing interest in this serious environmental health problem. This Committee played a key role in the enactment of the Indoor Radon Abatement Act, and Committee members have demonstrated national leadership in addressing radon in homes and schools through support of effective approaches to training and State program development.

Before I begin to discuss radon in schools this morning, I would like to put the radon problem in context.

SCOPE OF PROBLEM

Indoor radon contamination is one of the most important environmental health problems facing our country today. EPA and several national scientific organizations estimate that radon is the second leading cause of lung cancer in the United States. In

an intensive review of environmental health problems, a report on "Unfinished Business: A Comparative Assessment of Environmental Problems," a committee of senior Agency scientists ranked radon as the top environmental health problem facing EPA and the nation. Many leading health and scientific organizations, including the National Academy of Sciences and the Public Health Service share this perspective. Estimates of the health risk from radon exposure are based on the strongest possible evidence. Risk estimates for radon are based on human data from studies of thousands of underground miners.

Radon was first identified as a general public health threat in homes. Data collected through radon surveys conducted jointly by EPA and 25 States to date, have shown that radon is a widespread national health problem, affecting millions of homes nationwide. Elevated radon levels have been found in every State tested thus far. We estimate that about eight million or 10 percent of the nation's homes could have annual average radon concentrations above EPA's current action guideline of 4 pCi/L. As directed by Congress in the Indoor Radon Abatement Act, EPA is currently examining various action level options to update our guidance in the "Citizen's Guide to Radon."

Based on this information, EPA and the Surgeon General recommended in 1988 that all homes below the third floor of a building be tested for radon, and elevated levels lowered. This policy has been supported by the American Medical Association,

the American Lung Association, and several other national health organizations.

EPA is also concerned about the risk to children from radon. The limited data available to date suggest that children may be more susceptible than adults to cancers caused by radiation. The International Commission on Radiological Protection estimates that the risk to children from radon may be two to three times higher than the risk to adults. EPA is concerned about children's total exposure to radon, both at home and at school. The Agency believes that it is prudent public health policy to protect children from significant sources of exposure. This approach is based on the recommendations of a panel of independent experts under the auspices of the Agency's Science Advisory Board.

EPA'S RADON ACTION PROGRAM

Since the discovery of radon problems in homes in early 1985, EPA has designed a program to address all aspects of radon risk reduction through a non-regulatory partnership with States and the private sector. The program was designed based on the belief that radon risk reduction is best achieved by a concerted effort of Federal and State expertise and resources. We believe this same program is well-suited to address the radon problem in schools. Two important pieces of legislation have charted our course and greatly expanded our involvement in reducing radon risk. First, the Radon Gas and Indoor Air Quality Research Act of 1986 confirmed EPA's direction in problem assessment, research and technology.

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The 1988 Indoor Radon Abatement Act directed EPA to undertake a broad range of activities to achieve the national goal of making indoor air as free from radon as the air out of doors. Both laws directed the Agency's attention to radon in schools as well as homes.

The goal of our non-regulatory approach was and continues to be to reduce the public health risks of radon by 1) forming partnerships with the States and other Federal agencies, 2) working with States to inform and educate the public, and 3) developing technologies appropriate to address the radon problem and transferring them to enhance State and private sector capabilities. EPA's approach to identifying and addressing radon in schools has closely followed the model we developed to reduce radon health risks in homes: assess the problem, develop appropriate mitigation technologies, and provide technical assistance to develop State and private sector capabilities.

State Role

States are taking the lead in addressing the radon problem at the State and local level, with financial and technical assistance from the Federal government. All States have an existing network of environmental, health, and radiation protection agencies with considerable experience in responding to local problems. EPA has traditionally provided a broad range of technical assistance to States. This includes assistance in assessing radon potential in the State, designing effective radon programs including public

information strategies, and providing the technical training and assistance needed by State officials and the fledgling radon industry to meet the needs of the public.

I would like now to turn to what we have learned about radon in schools and how EPA has responded.

RADON IN SCHOOLS

EPA Recommendation

On April 20, 1989, EPA Administrator William Reilly issued a national advisory recommending that all schools be tested for radon. At the same time, technical guidance on school testing was sent to all States and to national public and private school organizations to provide the information needed to test schools. In addition, EPA has worked with national school organizations such as the National Education Association (NEA) and the Parent Teacher Association (PTA) to educate parents, teachers and school administrators about radon.

EPA's recommendation was based on the results of an EPA study which confirmed elevated radon levels in schools throughout the U.S. Although initially many scientists believed that ventilation systems in schools would preclude high radon levels similar to those found in homes, this conclusion appears to be erroneous. Elevated levels have been documented in schools in States across the country, including Maine, New Jersey, Georgia, Tennessee, Indiana, Illinois, Missouri, Kansas, Minnesota, North Dakota, New Mexico, Colorado, Wyoming, Montana, Nevada, and Washington.

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As with homes, the only way to know if a school has a radon problem is to test. To support States and school districts in identifying and addressing radon problems, EPA has issued interim guidance on school testing and mitigation. Although school testing and mitigations can successfully use many of the approaches developed for homes, radon concentrations in schools are influenced by special factors such as building construction; heating, ventilation, and air conditioning systems; and occupancy patterns. EPA's technical reports on measurement and mitigation take these factors into account.

I would now like to summarize for you EPA's activities in assessing radon in schools, our progress in developing mitigation technology and our efforts to develop State and private sector capabilities to address radon in schools.

Addressing Radon in Schools

School Assessment Activities

In 1988, EPA conducted radon testing in several schools in Fairfax County, Virginia, with the assistance of local school officials. As a follow-up to this initial effort, in early 1989 EPA conducted a study of radon levels in 130 schools in 16 States. The primary goals of these studies were to investigate how testing a school may differ from testing a home, and to assess the potential scope of the problem in schools. Schools were already beginning to test using the approach outlined for homes. Since

schools are constructed and occupied differently, it was important to identify appropriate measurement procedures for schools.

Key findings of these studies were:

- Elevated levels of radon were found in some schools throughout the country.
- Elevated levels were found in schools in each of the 16 participating States. Fifty-four percent of the 130 schools had at least one room measurement over 4 pCi/L. Twenty percent of the 3,000 rooms tested were over 4 pCi/L. Schools in several States had radon measurements exceeding 100 pCi/L.
- Radon levels can vary significantly from school to school in the same area.
- Within a school, there can be significantly different radon levels room to room. This means that the radon level in a school cannot be characterized based on measurements for only a few rooms.
- Rooms in contact with the ground had the highest radon levels (second story rooms had much lower levels).

We are continuing our assessment efforts on several fronts. EPA is currently conducting year-long radon tests of selected schools in 7 States. The study will be completed this summer. This information will be used to refine the interim report, and to provide flexibility for schools to develop school testing plans.

National School Survey

As required by the 1988 Indoor Radon Abatement Act, EPA is currently designing a national school survey. The survey will provide a statistically valid national picture of radon in schools. We hope to begin the survey this fall in States across the country, and results are expected in about two years. While the survey will be useful in providing general statistics on radon in schools, it will not be extensive enough to predict radon risks for schools in specific areas. Individual schools will still be advised to test.

Radon Reduction in Schools

EPA has a number of activities underway to develop effective mitigation technologies. The Agency has undertaken initial investigations and demonstration projects in several States. Initial results indicate that radon reduction technologies proven successful in homes are also applicable to many schools. Unique characteristics of schools, including construction, air handling system design and operation, and occupancy patterns often have a significant effect on radon levels, and thus may require diagnostic and mitigation approaches unique to schools. As with mitigation of homes, diagnostic and mitigation approaches must be developed to address the specific characteristics of each school. In addition, school mitigation work must be done in compliance with applicable local building, fire, and other safety requirements. EPA recommends that school officials work with experienced radon

mitigation contractors and HVAC professionals to determine feasible and cost-effective mitigation options.

Effective School Mitigation Methods

EPA has initially identified two primary approaches to school mitigation: adaptation of the sub-slab depressurization system successfully used in homes, and modification of school heating, ventilation and air conditioning (HVAC) systems. Both approaches have proven effective in significantly reducing radon levels. For example, an EPA demonstration project in school buildings in Nashville, Tennessee, successfully reduced elevated radon levels to below the current EPA guideline of 4 pCi/L.

Research and Demonstration Activities

EPA's initial research, development and demonstration program efforts resulted in the successful application of residential radon reduction techniques to schools, preliminary identification of typical school construction types, and development of mitigation approaches using existing school heating, ventilation, and air conditioning systems. EPA's technical assistance also led to construction of several new schools with radon resistant features.

EPA is expanding its research, development, and demonstration program for schools in 1990. Major efforts will include:

- Demonstrating the application of specific mitigation systems, depending on regional variations in geology, construction, and climate.

- o Initiating an effort to investigate mitigation approaches for difficult schools. Over the longer term, difficult-to-mitigate schools will be emphasized.
- o Quantifying physical characteristics of schools throughout the country in order to effectively target subsequent school research projects. Characteristics to be studied include building structure and heating, ventilation and air conditioning system design.

Cost of School Testing and Mitigation

Testing a school is relatively inexpensive compared to many other costs incurred by schools. If school personnel are used to deploy radon measurement devices, a typical school can be tested for under $1000, following EPA's recommendation that all classrooms in contact with the ground be tested.

As with homes, there is no "standard" corrective action for radon mitigation in schools. Costs for radon reduction will be school-specific and will depend on the initial radon level, school design and construction, and the ability of school maintenance personnel to participate in radon diagnostics and mitigation.

Based on limited experience, EPA estimates that diagnostic activities in schools where elevated radon levels are discovered will cost approximately $2000 to $5000 per school. Most schools are expected to incur costs of $3000 to $15,000 for mitigation. Particularly difficult schools would cost more. Costs for specific

mitigation methods vary. The two most promising techniques for mitigating schools are sub-slab depressurization and modification of HVAC systems.

To put these costs in perspective, the average cost for asbestos mitigation under EPA's Asbestos School Hazard Abatement Act is about $200,000 to $220,000 per school, and can be over $1 million in difficult cases. As I have discussed, we expect schools to be able to reduce their radon levels at much less cost. We have found radon reduction in homes to be very cost-effective and expect the same result in schools.

Technical Assistance to Schools

Consistent with our approach to radon in homes, EPA has provided technical assistance to States and school districts through training and through the development of public information documents on radon in schools.

Training

EPA has established a School Evaluation Program, modeled on the successful House Evaluation Program. The program is designed to add to our knowledge of radon entry and effective mitigation approaches, particularly HVAC, for schools. In FY 1990 the program will be conducted at approximately 15 schools in 5 locations across the country. Many schools are interested in participating in this type of program.

The resulting information on school diagnosis and mitigation will be used to develop a Schools Technology Transfer Program to be implemented by EPA in conjunction with its Regional Radon Training Centers. When it is implemented, the Technology Transfer Program will provide technical assistance on diagnostic and mitigation techniques to school officials and private sector contractors. The program will educate school officials, States, the private sector and the general public about radon in schools.

Regional Radon Training Centers will be an increasingly important source of expertise and training on radon in schools. The Centers are currently developing a radon reduction course for school administrators and private contractors. The Training Centers have also offered a training course for school administrators, risk and safety managers in school districts, and maintenance personnel, which covers basic radon information and options for reducing radon in schools.

In addition, EPA plans to conduct a technical forum with recognized experts on radon in large buildings in June 1990. The purpose of the forum is to exchange up-to-date information on the impact of ventilation systems on radon in large buildings, including schools. Participants will include representatives from key organizations dealing with indoor air quality, including government officials and building code organizations.

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Public Information

Over the past few years, public awareness of radon problems in homes and schools has grown. Our goal is to assist States in educating the public about radon risk and the need for action. EPA's approach has been to develop the highest quality informational material for States to distribute to the public.

In response to the national radon problem, and the evidence of limited public action, we began working with States to identify ways to better motivate the public to take action. As a result, we began shifting the emphasis of our public outreach materials from a purely informational tone to a more motivational message. We have embarked on a national media campaign to motivate public action.

Approaches to School Outreach

We hope to expand our public information and education efforts in the future, and to find even better ways to increase public action. EPA has implemented a number of activities to encourage informed radon reduction in schools. In cooperation with the National Education Association (NEA) and the Parent Teacher Association (PTA), EPA developed a brochure for parents and teachers which explains the radon health threat in schools and encourages testing. The brochure has been widely distributed to nearly 600,000 NEA and PTA members, and to 42,000 school districts across the country.

EPA has also developed educational materials, published in conjunction with an article outlining education activities, for junior and senior high school teachers. In 1990, EPA initiated an innovative outreach program with affiliates of the American Lung Association. Several of these groups are addressing radon in schools, including developing school curriculum, school testing programs, and radon awareness programs for parents, teachers, and school administrators.

Radon and Other Environmental Health Issues in Schools

EPA has initiated several activities to take a more holistic approach to environmental health risks in schools. In June 1989, EPA established the Hazards in Schools Coordination Committee to address asbestos, lead, radon, and other indoor air quality problems in schools. The purpose of the committee is to provide a forum within the Agency to facilitate regular communication among the Agency programs dealing with schools, to share information, to discuss issues related to schools, and to coordinate activities, as appropriate. Workshops on " Hazards in Schools", a Hazards in Schools resource booklet, and a recent mailing of school-related materials to 42,000 school districts are examples of the collaborative efforts of this Committee.

The Hazards in Schools resource booklet addresses radon, asbestos, indoor air, lead in drinking water and other issues of concern to schools. The brochure is designed to educate school officials on potential health risks in schools and to provide them

with sources of further guidance. The booklet will be distributed this summer to States and national school organizations.

In October 1989, EPA presented six workshops on Hazards in Schools. These workshops, co-sponsored by 14 national school organizations, were designed to assist school officials in dealing with several important environmental pollutants in their schools - radon , asbestos, and lead in drinking water. The workshops provided school officials with a greater understanding of the health concerns, recommendations, and requirements that the Agency has for addressing these issues.

State Grants

The Indoor Radon Abatement Act of 1988 gave EPA its first authority to make grants for the purpose of establishing and enhancing radon programs at the State level. We are pleased that 48 States, the District of Columbia, Puerto Rico, Guam and the Virgin Islands have asked for, and will receive, grant assistance to be used as seed money to establish radon programs. Our goal with this grant program is to develop continuing basic capabilities in each State to respond to the informational and technical needs of the public, and to address radon in homes, schools, and public buildings, before ending Federal grant assistance after three years.

We have designed a program which allows the States a great deal of flexibility in choosing the activities that are most appropriate for their needs. This year grant funds for individual

States will generally range from approximately $50,000 to $250,000 and may be used for a wide variety of activities which can be specifically targeted to radon in schools. As part of the State grants program, and to meet the statutory priority for innovation, EPA has also made seed money available to several States to develop and transfer innovative approaches to radon reduction.

In the first grant year, many States are beginning to address radon in schools, primarily through problem assessment or outreach activities. Several States are conducting various types of assessment activities in schools, and in some cases day care centers, using grant funds. Kentucky and Georgia have planned teleconferences to educate school administrators and facilities personnel about radon risks and appropriate reduction strategies for schools. New Jersey will design a model radon curriculum and implementation plan for high school students. Finally, Washington State and a local government have joined forces to develop a model program addressing radon problems for low-income school districts.

MANDATORY SCHOOL TESTING

As I have noted, EPA and many members of the scientific community believe that radon is an important national health risk. EPA has recommended that all schools be tested, and is actively working with States and educational organization to facilitate testing.

EPA believes that our current approach will be effective for schools as well as homes. EPA intends to evaluate how schools are

responding to our testing recommendation before additional action is considered. There are preliminary indications of increased school testing activity; we would like to conduct a more comprehensive review and will make this information available when it is complete.

EPA will provide the Committee with our technical comments on S. 1697 for the record, but at this time it is inappropriate to conclude that additional legislation with respect to testing is necessary. We oppose any legislation that establishes a new grant or loan program for radon testing in schools.

CONCLUSION

We have made good progress to date in addressing radon in homes, primarily because of EPA partnerships with the States and the private sector. Although the Federal role is important, radon is not primarily a Federal issue. States play a vital role in determining which activities are most appropriate for their particular State, and for assisting schools in reducing radon risk. States are beginning to take a more active role in addressing radon in schools. As I have suggested, EPA would like to provide the Committee with a review of State activities in implementing our recommendation that all schools be tested.

Our work on radon in schools is still in the initial stages, addressing important technical questions and developing State and private sector capabilities. We will continue to work with States to educate school administrators and encourage radon risk reduction

in schools. As we have for radon in homes, I am confident that EPA will effectively leverage State and private sector capabilities. In the coming year, we will conduct training and make outreach available to schools, working through the Regional Radon Training Centers and with States through the State Grant program. The grant program provides States an opportunity to establish a State-specific approach to address radon in schools.

In addition to improving and expanding our State and Federal partnerships, and motivating schools to reduce risk, our program will continue to develop the technical capabilities of the private sector and the States. Only through ensuring solid technical expertise and confidence in these programs will schools have the confidence to take definitive action to reduce radon risk.

That concludes my prepared statement, Mr. Chairman. I would be pleased to answer any question the Subcommittee may have.

Testimony from the New Jersey
Department of Environmental
Protection on S.1697
Presented by Dr. Jill Lipoti
Assistant Director, NJDEP
Before Senate Subcommittee on
Superfund, Ocean and Water Protection

May 23, 1990

Good Morning Chairman Lautenberg and Members of the Subcommittee on Superfund, Ocean and Water Protection. Thank you for the opportunity to comment on the pending Senate legislation, S-1697 which would require each local educational agency to test each school building. The New Jersey Department of Environmental Protection (NJDEP) supports this legislation and lauds the efforts of Congress to address this issue. I would like to address three issues in my comments: 1) the health risk from radon exposure faced by children, 2) New Jersey data on radon levels in schools and 3) comments on the proposed legislation.

As you may be aware, the scientific information on lung cancer risks for children is uncertain. Some scientists believe the risk is somewhat more for children than for adults, some believe it is less. The United States Environmental Protection Agency (EPA) has been mandated, thru the Indoor Radon Abatement Act, to address this point in its updated "Citizen's Guide to Radon". We look forward to reviewing EPA's analysis of this subject.

For the moment, I can present a brief qualitative overview of the subject. Most of the data relating lung cancer to radiation exposure during childhood comes from studies on Japanese atomic bomb survivors. (It should be noted that the atomic bomb survivors were exposed to an acute, external dose of radiation which differs from the mostly long term, internal dose of radon exposure.) While this data suggests that children may be more susceptible than adults to cancers induced by radiation, sufficient time has not yet elapsed to determine if the higher rate of lung cancer development in the exposed children will persist. Normally lung cancer does not appear until a person is at least 40 years of age and in most cases lung cancer is discovered between the ages of 50 and 65. Several reasons why children may be at a higher risk are: children have smaller lung volumes and higher breathing rates, which may result in higher radiation doses from a given radon concentration and the probability that a specific dose of radiation will induce cancer may differ with age. The NJDEP believes it is wise to consider the health risk for children to be as great as the risk for adults until more definite information is available.

Staff in the NJDEP Radon Program recently prepared a paper for the EPA's 1990 International Symposium on Radon and Radon Reduction Technology which addressed Radon Levels in Non-Residential Buildings in New Jersey (see attached). This paper presented information collected through the NJDEP's confirmatory testing program from January 1986 through August 1989. Among the information collected was radon testing data from 69 schools located in eleven counties. The radon levels ranged from .1 to 95 pCi/l with an average (arithmetic) radon concentration of 3.94 pCi/l. Three out of the eleven counties indicated average school radon concentrations of greater than 4.0 pCi/l. In addition, ten of the counties had at least one school radon reading exceeding 4.0 pCi/l. This paper also included information on other non-residential structures, such as hospitals, municipal buildings, churches, and professional buildings. Of the 637 radon measurements collected in 141 buildings throughout the State, thirty seven percent (37%) exceeded 4.0 pCi/l and over four percent (4%) exceeded 20 pCi/l. This work indicates that elevated radon levels do occur in schools and other non-residential structures and that it is widespread within the test areas of the State. (School data in this work comes primarily from the north and central sections of New Jersey.)

Concerning the legislation before this subcommittee, this bill, in overview, contains many worthy points. In particular, the condition to limit the mandatory testing to areas identified as having elevated levels of radon within a state; the decision to test all types of schools, public and private; the notification of results process; the decision not to mandate remediation but rather to allow the local educational agencies to decide that issue; and the allocation of funds to assist local educational agencies in testing and, if necessary, remediating school buildings for radon are commendable.

There is, however, one area that is not addressed in this legislation which I believe would be a positive addition. This legislation does not address the issue of what happens to schools who have already tested for radon, a 'grandfather clause'. This situation might be quite prevalent in the Northeast section of the United States and in Florida. It is difficult to suggest draft language for this type of clause due to the diversity and maturity of radon programs throughout the United States. However, following is an attempt at such language:

> "Schools which have tested a building prior to the establishment of this act and have conducted the tests in accordance with any guidelines established by the Administrator shall not be required to retest a building. Such schools shall submit a report to the Administrator which outlines the outcome of the test results."

Possibly one area that could be improved in the existing legislation is the financial assistance process. Schools should be encouraged to test and remediate on a timely basis. The ranking and review processes outlined in Section 4, (b) et seq. might lead to a delay in testing and remediation until the outcome of the request is known by the local educational agency. Then there may be an additional delay while the district seeks alternate methods of financing. The goal of the legislation might be better served through a reimbursement plan for needy educational agencies rather than through a loan/grant program. There are, of course, pros and cons to this type of plan; appropriations would not go as far as they would in a loan program and they would probably only go to the most needy educational agencies. But this type of plan would seem to better serve the intent of the legislation which is to reduce individuals exposure to radon in school buildings on a timely basis.

Once again, thank you for the opportunity to address this subcommittee and comment on the pending legislation S-1697. If you have any questions, I would happy to address them.

LEGISLATIVE INFORMATION

TESTIMONY
OF THE
NATIONAL EDUCATION ASSOCIATION
AND
THE NATIONAL PARENT-TEACHER ASSOCIATION

ON THE
RADON TESTING FOR SAFE SCHOOLS ACT
S. 1697

SUBMITTED TO THE
SUBCOMMITTEE ON
SUPERFUND, OCEAN AND WATER PROTECTION
U.S. SENATE

PRESENTED BY
HARVEY PRESS
PRESIDENT
NEA-RHODE ISLAND

MAY 23, 1990

KEITH GEIGER, President
ROBERT CHASE, Vice President
ROXANNE E. BRADSHAW, Secretary-Treasurer

DON CAMERON, Executive Director

Mr. Chairman and Members of the Subcommittee:

I am Harvey Press, President of the National Education Association-Rhode Island. I appreciate the opportunity to speak to you today representing the 2 million-member National Education Association and the 6.6-million member National Parent-Teacher Association.

NEA and National PTA appreciate your efforts, Mr. Chairman, and the work of Senator Chafee and others on the Subcommittee to draw attention to the hazards of radon in the schools and devise solutions to the problem. In particular, we commend you for sponsoring the Radon Testing for Safe Schools Act, S. 1697.

We have only recently become aware of the dangers of radon contamination in America's schools. Yet preliminary Environmental Protection Agency studies indicate that the presence of radon in school buildings is so widespread that we must not delay further in identification and mitigation efforts.

NEA and National PTA are deeply concerned about the hazards of radon, a colorless, odorless gas formed by the decay of radium and uranium. Outdoors, radon is widely dispersed, but indoors radon accumulates to hazardous levels because air flows less freely.

The extent of radon hazards

EPA estimates that as many as 20,000 lung cancer deaths a year are attributable to radon exposure; only cigarettes

cause more. Radon breaks down into radioactive decay products called radon "daughters" or "progeny." These decay products attach themselves to dust particles and, if inhaled, can adhere to passageways in the lungs. In the lungs, radon progeny decay further, emitting alpha particles which can damage cells. This damage can cause cancerous cells to form.

School buildings, especially those that have undergone recent renovations to enhance their energy efficiency, frequently have high levels of radon. Airtight buildings are more likely to trap high concentrations of radon. In addition, because school buildings are usually structures with large amounts of contact with the ground, there may be many entry points. School heating and air conditioning systems may produce unbalanced air flows and negative air pressure, exacerbating radon levels.

Children -- because their metabolism is more rapid and they inhale more often than adults -- are more at risk than adults from the hazards of radon. Because they are in early stages of their physical development, they are also more susceptible and at a greater lifetime risk of developing cancer as a result of radon exposure. A representative of the Conference of Radon Control Program Directors stated that exposure to radon during the first 10 years of life represents one-third of the risk of total exposure over 70 years.

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Radon is a health hazard throughout the country, but more so in areas with large deposits of radon-bearing minerals: uranium, granite, phosphate, and shale. Factors such as soil permeability, the proximity of uranium to the surface, and the type of construction of a building can affect the amount of radon that seeps indoors. Radon can enter a building in many different ways: through the crawl spaces or cracks in the foundation, through water supplied by underground wells, through joints in the foundation, loose fitting pipes, or through permeable construction materials such as bricks and concrete.

Because radon cannot be seen or smelled, specialized equipment is needed to detect its presence. Radon gas is measured in terms of picoCuries per liter (pCi/l) of air, and radon decay products are measured in terms of working levels (WLs). One WL is equal to approximately 200 pCi/l of radon.

According to EPA estimates, the number of persons expected to die of lung cancer as a result of radon exposure over their lifetimes can be as high as between 440 and 770 per 1,000 for those exposed to 1.0 WL of radon; as high as 270 to 630 for those exposed to 0.5 WL of radon; and as high as 120 to 380 for those exposed to 0.2 WL of radon. Persons are at risk even if they are exposed to radon levels below EPA's radon action guideline of 0.02 WL (4 pCi/l).

In fact, the EPA has stated there is no safe level of radon exposure. The EPA action level of 4 pCi/l poses such

a high cancer risk that one person out of 100 will fall victim to lung cancer as a result of radon exposure at that level. Other studies have put the risk as high as one in 30 or one in 65. The standards for most contaminants regulated by EPA allows for a cancer risk of only one in 10,000 to one in one million. Looking at the risk another way, EPA's action level is the equivalent of having 200 chest x-rays per year.

A preliminary study, conducted by EPA in 1989, tested radon levels in 130 schools in 16 states: Colorado, Georgia, Illinois, Indiana, Kansas, Maine, Minnesota, Missouri, Montana, Nevada, New Jersey, New Mexico, North Dakota, Tennessee, Washington, and Wyoming.

Almost 20 percent of the 3,000 individual schoolrooms tested had radon levels above the action guideline -- 4 pCi/l -- and 3.0 percent had radon levels above 20 pCi/l. More than half of all schools had at least one room with radon levels above 4 pCi/l, and the highest level found was 136 pCi/l -- a cancer risk equivalent to smoking 17 packs of cigarettes a day.

In Pennsylvania, a state survey of 140 schools in a high risk area, including the Reading Prong, uncovered 43 buildings with elevated radon levels. Some readings in this survey were as high as 92 pCi/l, 23 times the EPA-recommended level. In New Jersey, the Department of Environmental Protection tested 41 school buildings. Half

of those buildings, including 17 that were occupied by children, were found to have radon levels above 4 pCi/l.

Effective testing and mitigation methods

Testing for radon is relatively easy and inexpensive. In contrast to testing for hazardous asbestos, radon testing can be carried out by school personnel using methods approved by EPA. Among the testing devices used to measure indoor radon levels are charcoal cannisters, alpha track detectors, and continuous working level monitors. EPA estimates it will cost an average of $1,000 to test a school.

In the same way, mitigation techniques for reducing radon levels are straightforward, and can often be accomplished by school personnel or general contractors.

Methods of sealing off entry routes to prevent radon from entering a school building might include covering exposed earth with concrete or gas-proof liners, filling cracks and holes in concrete walls and floors, covering sumps, or placing removable plugs in untrapped floor drains.

Improving the air circulation to prevent radon from being trapped in a school building can be accomplished by opening windows or vents, or by using fans or heat recovery ventilators.

Increasing the soil ventilation to prevent radon from entering a building by drawing the gas away from the foundation before it enters can be achieved by using active

ventilation techniques, including hollow block wall ventilation and sub-slab ventilation.

NEA and PTA involvement in hazard abatement

For many years, NEA and National PTA have worked to eliminate the environmental health hazards plaguing public schools. In particular, our organizations have been key players in drawing attention to the threat of cancer-causing asbestos in schools and in working with Congress to develop remedies to eliminate this hazard. Congress has made significant progress in recent years to provide resources and guidance to school districts to conduct appropriate asbestos abatement work.

In the previous Congress, NEA and National PTA supported the Indoor Radon Abatement Act, P.L. 100-501, which authorized $10 million a year for grants and technical assistance to states to establish comprehensive responses to the threat of radon, and requires EPA to conduct a national survey of school facilities for radon. In Fiscal Year 1990, Congress appropriated $1 million for this survey. EPA is preparing to begin this survey in 24,000 classrooms in 1,200 schools around the country. The agency expects to prepare its analysis in the Fall of 1991 and report to Congress in the Spring of 1992.

In addition, our organizations have distributed 115,000 copies of a brochure, prepared by EPA in consultation with NEA and National PTA. The publication, entitled "Every

School Should Take This Simple Test," is designed to advise parents and public school employees of the dangers of radon and appropriate testing and mitigation methods. A copy is attached for the record. We have also cooperated with EPA in developing a handbook entitled "Environmental Hazards in the Schools," which includes a chapter on radon. The book is expected to be published soon.

NEA and National PTA believe that all educational facilities must be safe from the hazards of radon. We support federal legislation to require testing of public school buildings for radon. Our organizations also support federal assistance for schools to take immediate corrective action when radon levels exceed EPA's radon action guidelines. Moreover, we recommend that current radon testing procedures be evaluated to determine which are truly effective, and that the current action guideline of 4 picoCuries per liter be lowered as research reveals the full extent of the hazards associated with radon exposure. Schools and other interested parties should also be apprised as EPA determines better methods for mitigation.

Provisions of the bill

NEA and National PTA strongly support the Radon Testing for Safe Schools Act, S. 1697. This legislation would authorize $5 million for radon testing in the schools, and $5 million per year between FY92 through FY96 to assist schools with the costs of mitigating high levels of radon.

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The measure is reasonable and prudent, and -- in fiscal terms -- a modest approach to a serious health hazard. Using current EPA data and information gathered from the school survey EPA is conducting, S. 1697 would require radon testing in schools in geographic areas identified as having elevated levels of radon. Testing would be conducted prior to September 30, 1993, and the results would be made available to interested persons in the community: parents, teachers, and other school personnel.

Moreover, S. 1697 would require EPA to establish a Radon Testing and Mitigation Assistance Program. A key purpose of this unit within EPA would be to provide financial assistance to schools for radon testing and mitigation. Applications would be evaluated based on the financial need of the school and the nature and magnitude of the potential exposure to radon.

Other provisions of the bill call for an annual report of activities under the program and penalties for noncompliance.

The legislation does not require that schools take action to mitigate radon contamination, but schools with radon concentrations at or above 4 pCi/l certainly should take action. We recommend that the bill be amended to require schools with levels above 20 pCi/l to take corrective actions, and those with levels between 4 pCi/l and 20 pCi/l to conduct more comprehensive follow-up tests.

The grant and loan program in the bill is essential. Many schools face severe economic difficulties in meeting their many competing budgetary needs. In fact, rising construction costs and increasing pressure to address previously neglected physical plant needs have resulted in an increase in capital outlays by U.S. public schools of more than $1.3 billion, or 12.6 percent, between 1987-88 and 1988-89. The grants and loans would be distributed using a method similar to the Asbestos School Hazard Abatement Act.

We also recommend that the $5 million authorized to assist schools in radon testing be doubled. If we assume that 20 percent of schools would be required to test that would result in 20,000 school buildings. At the estimated average cost of $1,000 per building this would amount to $20 million. Providing $10 million would allow the federal government to meet half of these costs.

While S. 1697 would require testing only in locations that are likely to have high radon concentrations, NEA and National PTA strongly recommend that all schools test for radon to establish with certainty whether or not a health hazard exists. EPA has prepared two documents, "Radon Measurements in Schools" and "Radon Reduction Techniques in Schools," to assist schools in this effort. We ask that Congress and the appropriate federal agencies, including EPA, continue to inform Americans about the serious health hazards associated with exposure to radon, and increase their efforts to provide information and technical

assistance -- as well as the financial resources -- necessary to eliminate this danger from America's schools.

Thank you.

American Academy of Pediatrics

T E S T I M O N Y

BEFORE THE

UNITED STATES SENATE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS SUBCOMMITTEE

ON SUPERFUND, OCEAN AND WATER PROTECTION

ON

"RADON IN SCHOOLS"

Presented by:

John DiLiberti, M.D., F.A.A.P.

May 23, 1990

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Mr. Chairman, members of the committee, and staff:
I am John DiLiberti, M.D., a member of the Committee on Environmental Hazards of the American Academy of Pediatrics, and testify today on behalf of the Academy. In addition I am Director of Pediatrics at Saint Francis Hospital and Medical Center, in Hartford, Connecticut and Professor and Associate Chairman of the Department of Pediatrics at the University of Connecticut Health Center. I appreciate this opportunity to speak today in favor of Senate Bill 1697, requiring local educational agencies to conduct testing for radon contamination in schools.

Radon, a colorless, odorless gas is found in varying concentrations in both indoor and outdoor air throughout the world. Its presence is a consequence of the natural radioactive breakdown of the uranium (and subsequently radium) which is present, on the average, at levels of several parts per million in most rocks and soils. Radon may enter buildings and accumulate in concentrations substantially larger than in outdoor air.

As radon gas in room air disintegrates, it is transformed into atoms of the solid element, polonium, which generally attach to minute particles of dust. This polonium, also intensely radioactive, may then be inhaled and deposited in the passageways of the lungs. As it subsequently disintegrates, adjacent lung cells are subjected to very intense radioactive bombardment. Irrefutable evidence demonstrates that over many years continued irradiation of

the cells lining the passageways of the lungs will lead to cancer.

Although we are here today to talk about the risks from radon in indoor air, our earliest knowledge of radon-risks comes from the unfortunate exposure of uranium miners in Colorado and Europe. Since natural radon production in earth or rocks is basically proportional to the amount of uranium present, clearly an unventilated uranium mine would have extremely high concentrations of radon. By the 1950's miners who had many years of exposure had high lung cancer risks, with workers in one European mine having a 50% death rate from lung cancer.

Despite considerable accumulation of knowledge about occupational exposures to radon over the past four decades and, I might add, apparently successful abatement efforts which have reduced these risks to reasonable levels, an appreciation for the potential risk of indoor radon in residences and public buildings has become apparent only in the past 5 - 10 years. The 1984 experience of an engineer setting off an alarm in the Limerick, Pennsylvania nuclear power plant as a result of home exposure to radon is generally credited as the event which raised national consciousness on this issue.

Radon formed in the ground enters buildings through a number of mechanisms such as cracks in foundations, openings for water pipes, and other entry points which have been

reasonably well characterized. Once present in a building it remains until it disintegrates or is removed or diluted by ventilation. In summary then, the key determinants of the radon level in a given room may be divided into three major groups:

1. The radon production rate in the underlying soil and rock;

2. The type of building construction and any subsequent deterioration determine how easily radon may enter the building;

3. The amount of ventilation and air mixing in a given room determined by factors such as the location (basement rooms have higher concentrations since they are close to the source), time of year (when windows and doors are open levels decrease) and the state of the ventilation system (older or poorly maintained systems move less air, allowing for greater radon buildup.)

The guideline generally agreed upon for excessive radon concentrations in indoor air is 4 picoCuries per liter (sometimes also given as 0.02 working levels, the unit of occupational exposure). At this level, which corresponds to a ratio of one part radon for every million trillion parts of air, approximately 4 radon atoms disintegrate each second in every cubic foot of air. Average indoor air concentrations

of radon in the United States appear to be on the order of 1/3 of the guideline value but nationwide it appears that at least 20 - 40% of homes and schools have one or more rooms which exceed the guideline. One schoolroom in New Jersey had a level 21 times higher and a home in eastern Pennsylvania was 750 times higher than the 4 picoCurie guideline. In Connecticut the Department of Health Services has identified a school which had a room with a level over 12 times higher than the guideline.

Since the vast majority of available data on the induction of lung cancer is derived from exposed miners, the health effects of radon on children must of necessity be extrapolated from this adult information. Although the lowest levels of occupational radon exposure proven to cause lung cancer are slightly higher than those typical of indoor radon exposure in this country, there is enough overlap to be confident of the carcinogenicity of elevated indoor radon levels. The EPA estimate of 5,000 to 20,000 lung cancer deaths annually due to indoor radon exposure is based on very conservative assumptions. A comparison with other radiation standards and exposures is sobering. A child who spends 7 hours each day for 180 days each year in a classroom with a 4 picoCurie level of radon (the EPA guideline maximum) will receive a radiation dose approximately six times higher than the maximal allowable exposure for any individual from nuclear reactors or waste disposal sites. This does not begin to include home exposure. This school exposure is also twice the maximum exposure to residents in the vicinity of

the Three Mile Island nuclear accident and over 100 times the average exposure. Thus, the 4 picoCurie target level does not appear to be stringent when compared with other radiation standards or exposures.

A universally taught maxim of children's health care in medical schools and training programs is "Children are not little adults", the message being that taking adult parameters and scaling downward by body size will not give numbers relevant to children in most cases. The marvelous nature of growth and development in children typically is associated with processes which occur at very different rates from adults. This leads to several concerns. First, that children have special risks because physiologic processes relating to growth may be peculiar to childhood, or may take place at higher rates in childhood. Second, children may be exposed to disproportionately greater amounts of hazardous substances because of their size, breathing rate, dietary patterns, etc. Since children both breathe faster than adults and appear to be more sensitive to the carcinogenic effects of ionizing radiation (based on Japanese atomic bomb survivor data) the risk of lung cancer from a given radon exposure may be higher in children than adults, increasing the urgency of our response to this hazard.

The American Academy of Pediatrics encourages passage of this bill in order to protect our children from unacceptably high risks of lung cancer. We do however, have two concerns:

first that we must be certain that a sufficient number of competent contractors is available to carry out the necessary work involved and second that the meaning of "an area identified as having elevated levels of radon" on lines 4 and 5 in section 2a is vague. Newly constructed schools with well-maintained ventilation systems may have low classroom radon levels despite high production rates in the underlying geologic structures. Conversely, poorly maintained, older schools may have unacceptably high levels despite locations in geographic areas with inherently lower radon production risks. The goal of this legislation ought to be to identify and remediate on a priority basis the school classrooms with the highest radon levels. Poor, inner-city schools, could perhaps be less likely to receive attention if the current wording is kept. We suggest rephrasing this section to include the known risk factors for elevated classroom radon levels which go beyond the single geographic factor implied in the current wording.

Thank you for the opportunity to present our views on this important subject.

United States General Accounting Office

GAO Testimony

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Improvements Needed in the Environmental Protection Agency's Testing Program for Radon Measurement Companies

Statement for the Record by Richard L. Hembra, Director
Environmental Protection Issues
Resources, Community, and Economic Development
Division

Before the
Subcommittee on Superfund, Ocean and Water
Protection
Committee on Environment and Public Works
U.S. Senate

GAO/T-RCED-90-81

Mr. Chairman and Members of the Subcommittee:

We are pleased to present a statement for the record that discusses (1) our report[1] on the Environmental Protection Agency (EPA) program that assesses radon measurement companies' competency, and (2) the results of our current review on changes needed in this program to provide homeowners with greater assurance that radon measurements are accurate, and on state efforts to control radon measurement companies. This work was done at the request of the House Committee on Science, Space and Technology and the results were presented in testimony before the Committee's Subcommittee on Natural Resources, Agriculture Research, and Environment on May 16, 1990.

Radon, a naturally occurring, colorless, odorless gas has been shown to cause lung cancer. EPA estimates that 20,000 lung cancer deaths each year can be attributed to indoor radon. As a result, EPA and the Public Health Service have advised residents to test their homes for radon and take action when elevated levels are found.[2] In 1986, to help ensure that homeowners obtain accurate radon measurements, EPA published procedures for taking radon measurements and established the voluntary Radon Measurement Proficiency (RMP) program. More recently, Congress passed Public Law 100-551, commonly referred to as the Indoor Radon Abatement Act of 1988, which directed EPA to undertake a variety of activities to

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[1]Air Pollution: Uncertainty Exists in Radon Measurements (GAO/RCED-90-25, Oct. 16, 1989).

[2]While EPA maintains that no safe level exists, the agency recommends that homeowners take action whenever annual average radon levels are believed to be greater than about 4 picoCuries per liter of air. EPA estimates that the risk of being exposed to annual radon levels of 4 picoCuries is comparable to smoking half a pack of cigarettes each day.

address the radon problem. A number of these activities including the RMP program, were already underway as part of EPA's radon efforts.

The RMP program assesses the capabilities of companies providing test results to homeowners. The objectives of the program are to (1) assist the states and the public in selecting companies that have demonstrated competence in measuring indoor radon, and in the long-run (2) provide assurance to the public that companies' test results are accurate through the use of standardized measurement and quality assurance procedures. To achieve these objectives, EPA envisioned a federal/state approach. EPA would be responsible for testing the proficiency of firms, whose participation in the program would be voluntary, and would encourage firms to adopt quality assurance procedures. The states, according to EPA officials, would determine any additional regulation of firms such as mandatory participation in the RMP program and mandatory adoption of quality assurance programs.

OVERVIEW

EPA has made considerable progress in achieving the initial objective of the program. Since 1986 EPA has assessed companies' competency in measuring radon on six occasions. It has also published the results in national reports that are distributed throughout the country and in individual state reports. The reports list the companies that have demonstrated proficiency and device or devices they used to demonstrate it. The number of firms demonstrating proficiency through the RMP program has grown dramatically. For example, 24 firms demonstrated proficiency in EPA's first test held in 1986 while about 660 firms were listed in EPA's latest proficiency report (issued in January 1990). Of the 660 firms, EPA lists about 260 as national companies.

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Even with the increased number of firms demonstrating proficiency in measuring radon, EPA and the public still cannot be assured that all companies meet proficiency standards or that measurement results are accurate on a day-to-day basis. As we reported in 1989, this assurance does not exist primarily because

-- the voluntary nature of the program allows firms to market measurement devices that have not been tested or that failed a test and

-- the program does not require measurement companies to implement quality assurance programs that ensure quality measurement results on a day-to-day basis, and, consequently, companies may be providing homeowners with inaccurate results.

Further, only a limited number of states have assumed the responsibilities EPA envisioned in the federal/state approach. Our current work shows that only nine states have developed programs that provide some regulation of radon measurement companies.

BACKGROUND

Radon occurs naturally almost everywhere. Current estimates are that the average U.S. home contains about 1.5 picoCuries of radon. Several different devices are available to measure radon levels in the home. For example, the popular charcoal canister measures radon over 2 to 7 days. Another popular device, the alpha track detector, measures radon for longer periods such as 3 months to a year. Both devices, which can be purchased from various retail outlets, must be sent to laboratories for analysis after being exposed to radon. Some more costly devices that require skilled operators, such as the continuous radon monitor, can measure radon and provide more immediate results without laboratory analysis. Companies that provide the laboratory

analysis results or the results through the use of instruments used by a skilled operator are tested through the RMP program and are called primary companies.[3]

To pass the RMP program and be listed in the proficiency report, EPA requires a primary company to (1) follow the appropriate measurement protocols, (2) demonstrate the ability to get test results to the proper homeowner, and (3) demonstrate the ability to measure radon to within 25 percent of actual levels. To meet the first requirement, EPA generally relies on a company's statement in the application that it follows the protocols. To meet the second and third requirements, companies must pass a proficiency test, which includes correctly analyzing devices exposed to known levels of radon and reporting the results to EPA for verification.

FIRMS MARKET DEVICES WITHOUT MEETING RMP REQUIREMENTS

In October 1989 we reported that 87 percent of the devices companies had tested in the RMP program in 1988 met the RMP requirements, thus demonstrating a minimum level of competency in measuring radon. However, we also reported that the voluntary nature of the program allows firms to market devices that fail the program or that have not been tested in the program. When companies are allowed to market devices without demonstrating a minimum level of competency in measuring radon, consumers have no assurance that they are receiving accurate results. In fact, in a few of the cases cited below it appeared the companies may have been providing homeowners with inaccurate measurements. The

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[3]Primary companies either have laboratory capabilities to analyze radon measurement devices after they have been exposed to radon or measure the radon levels and analyze the results with their own instrumentation and operators. Secondary companies provide services ranging from distribution of radon devices to home inspection and consultation. Secondary companies must use a primary company to analyze the radon devices.

following are cases we reported which illustrate the lack of controls in the RMP program:[4]

-- One large and a few small companies were marketing devices that had not been tested in the RMP program.

-- One large company was marketing a device that did not meet the RMP requirements.

-- Several small companies were marketing devices after failing the proficiency test.

-- A few small companies that tested some of their devices in the RMP program had been marketing other devices that had not been tested in the program.

In addition, a company not in our sample but identified through discussions with contracting personnel, was analyzing devices in its laboratory under another name after it failed the proficiency test.

INDUSTRY OFFICIALS AGREE THAT MEASUREMENT FIRMS SHOULD BE REQUIRED TO DEMONSTRATE PROFICIENCY

One objective of our current review was to address changes in the RMP program that could provide homeowners with greater assurance that radon measurements are accurate. To help answer this objective we interviewed officials from a sample of the radon industry for their views and we found that they generally agreed that all measurement companies should be required to demonstrate

[4]In our review, we sampled all 11 large primary companies (having 30 or more secondary companies) and 100 of the 347 small primary companies (having fewer than 30 secondary companies) that participated in the 1988 testing. The precise estimates can be found on pages 7 and 50 of our Oct. 16, 1989, report.

proficiency in testing radon.[5] Of the 32 interviewed, 27 officials said participation in the RMP program should be mandatory. The reasons given for making participation mandatory included the following:

-- Radon health effects are severe enough to warrant obtaining assurance from companies that they are meeting RMP requirements.

-- The public needs assurance that they are dealing with reputable firms, and the RMP program is the only means available to companies for demonstrating competence in measuring radon.

RMP PROGRAM DOES NOT REQUIRE MEASUREMENT COMPANIES TO HAVE QUALITY ASSURANCE PROGRAMS

An effective quality assurance program is EPA's best assurance that radon measurement firms are performing quality testing on a day-to-day basis. The primary purpose of documented quality control is to assure that the capability demonstrated during performance testing is maintained until the next periodic evaluation, according to the former Chief, Office of Radiation Measurement, National Institute of Standards and Technology.

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[5]We interviewed a judgemental sample of 32 radon measurement industry representatives from 26 commercial, 3 university, and 2 state laboratories and 1 federal laboratory, all of which provide radon measurement services. We pretested our survey instrument with representatives of 3 commercial laboratories. To obtain viewpoints from all types of applicants, we divided the universe of 843 applicants for participation in EPA's 1989 proficiency test into four strata and then randomly selected and interviewed applicants from each strata. We selected 30 applicants, one of which had already been interviewed in the pretest. Information obtained reflects only the views of those interviewed and cannot be considered representative of the entire universe of applicants.

Although EPA recommends certain quality assurance procedures for radon measurement companies, the agency does not require companies to develop and implement such procedures as a condition for program participation. Recommended procedures include: controlled calibrations of measurement devices in a known radon environment, such as in a calibration chamber; background and duplicate measurements; written procedures for attaining quality assurance objectives; a system for recording and monitoring the results of quality assurance measurements; and maintenance of control charts and related statistical data.

If measurement companies do not develop and implement adequate quality assurance programs, they may be providing homeowners with inaccurate results. For example, in our prior work we found that only 12 of 21 companies we interviewed that participated in the 1988 testing were calibrating their equipment. One of the nine companies that did not calibrate its equipment failed the 1988 test with a 100-percent error but had been marketing the measurement device for a full year before the test. After calibrating its equipment, the company retested and passed.

In addition, not requiring measurement companies to implement quality assurance programs seems inconsistent with EPA's agency-wide quality assurance policy for EPA-sponsored environmental monitoring and measurement efforts. This policy requires every measurement project to have a written and approved quality assurance plan and applies to all EPA program offices, regional offices, laboratories, contractors, and grantees.

EPA's own Science Advisory Board has also recommended that the agency require radon measurement companies to maintain documented quality control and measurement procedures for measurement

devices.[6] Specifically, the Board recommended that both detailed descriptions of calibration procedures and calibration data for certain types of measurement devices be submitted with the application for admission to the proficiency testing program.

EPA program officials expressed concern about enforcing a quality control requirement and managing the costs associated with it. Nevertheless, EPA recently established a task force to assess changes that are needed in the RMP program. In a recent meeting, program officials told us that the task force was developing a proposal for changes in the RMP program that would include requiring measurement companies to have quality assurance programs as a condition for participating in the RMP program. In addition, as authorized by the 1988 radon legislation, EPA is developing a user-fee proposal to cover costs of the RMP program.

INDUSTRY OFFICIALS BELIEVE THE RMP PROGRAM SHOULD REQUIRE QUALITY ASSURANCE

Of the 32 officials from the radon testing industry we interviewed, 31 said some quality assurance should be required as a condition for participating in the RMP program. Some of the reasons these officials gave for requiring quality assurance included the following:

-- At the present time, the radon measurement area is wide open to abuse because homeowners cannot see, taste, or smell radon.

-- Quality assurance requirements would force industry to develop good quality control systems and standardize industry practices.

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[6]The Science Advisory Board is a group of independent scientists who review the quality and sufficiency of scientific data underlying regulatory development of some EPA actions.

-- A quality control system is needed as a link between a company's performance on the proficiency test and its everyday work.

STATES' MONITORING OF RADON MEASUREMENT FIRMS IS LIMITED AND INCONSISTENT

Another objective of our current review was to determine the status of state radon programs that exercise control over radon measurement companies. In designing the RMP program using a federal/state approach, EPA envisioned that states, through accreditation or certification programs, would exercise some degree of control over the reliability, consistency and quality of the measurement data companies provide homeowners. According to EPA officials, the agency envisioned that states would make participation in the RMP program mandatory and establish and enforce quality control requirements through state programs. We conducted a telephone survey of radon coordinators in 50 states and the District of Columbia to determine the progress states were making in establishing programs. (See app. I for a summary of the survey information on the status of state radon programs.)

The survey we conducted showed that only nine states have programs that either certify, license, or accredit radon measurement companies. All nine programs have a requirement that radon measurement companies participate in EPA's RMP program or in a similar state-run program. However, only five of the programs are mandatory. Three of the states with voluntary programs are attempting to pass legislation or implement regulations that would make their programs mandatory. The fourth state has no plans to change its voluntary program. Of those nine states that have programs, only five have quality assurance requirements.

An additional 20 states may establish a program in the future. Twenty-two state coordinators said their states probably would not have a program. Two reasons coordinators gave for not having a program were a lack of funding or resources for indoor air problems in general, including radon, and a lack of legislative authority for such programs.

Not only do states vary in whether or not they require mandatory participation in their programs, but they also vary in the number of requirements in their programs. The result is that each program gives a different level of assurance to homeowners regarding the accuracy of measurements. For example, five of the nine programs require companies to calibrate their equipment periodically and follow other quality assurance procedures. Four of nine programs provide for on-site inspection of measurement companies. The only requirement common to all nine programs is for companies to participate in EPA's RMP testing program and/or a similar state-run testing program. (See table I.1, app. I for a comparison of the various requirements of the nine programs.)

Although, we did not attempt in the survey to establish why some states had certain requirements and while others did not, one reason may be the lack of guidance from EPA. For the most part, EPA has not defined the degree of control it wants states to exercise over measurement companies. In a May 1988 report, EPA stated such control could include registration, certification and licensing.[7] According to the report, registration, certification, and licensing differences center around whether the control process is mandatory, whether nonparticipating (e.g., non-certified or non-licensed) firms are excluded from the market, and whether a fee is charged by the state for the process. Licensing is viewed as the most restrictive form of "quality control," while registration is

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[7]Key Elements of a State Radon Program, EPA 520/1-88-006, Office of Radiation Programs.

the least restrictive. The report noted that the RMP program illustrates a form of registration with no fee--the least restrictive form of control.

In an April 1990 meeting, EPA program officials told us that the radon task force was proposing that a document describing a model state certification program be developed for guidance to states.

CONCLUSIONS AND RECOMMENDATIONS

Since radon has been identified as a national health problem, EPA and the Public Health Service have advised homeowners to test their homes and take action if elevated levels are found. We believe that to make health-based decisions homeowners need more assurance that the radon test results they rely on are accurate. Homeowners would have greater assurance that radon measurements are accurate if (1) participation in the RMP program were made mandatory, and (2) radon measurement firms were required to meet minimum quality assurance requirements as a condition to participation. In designing the RMP program, EPA relied a great deal on states to develop programs that would exercise some control over the reliability, consistency, and quality of the measurement data companies provide to homeowners on a day-to-day basis. While some states have developed programs, most have not.

We are not opposed to states exercising control over measurement companies. However, to provide homeowners with a minimum level of assurance that radon measurements are accurate, we believe actions need to be taken at the national level. In our May 16 testimony before the House Subcommittee on Natural Resources, Agriculture Research, and Environment, we recommended that the Congress provide EPA authority to require companies to participate in and successfully pass the RMP program before marketing their devices to the public. In addition, to help ensure that radon measurement companies are providing quality measurement

results on a day-to-day basis, we recommended that EPA establish quality assurance requirements for the different measurement devices and, as a condition for participating in the RMP program, require measurement firms to demonstrate that they have developed and implemented programs that will meet the requirements. Finally, to ensure the development of state programs that provide a minimum degree of control and consistency over radon measurement companies, we recommended that EPA develop and issue guidance on the type of state programs and level of control it believes is needed at the state level in order to provide homeowners with adequate assurance that radon measurements are accurate.

STATUS OF STATE RADON PROGRAMS

To obtain a nationwide perspective on how states exercise control over radon measurement companies, we conducted a telephone survey of state radon coordinators in the 50 states and the District of Columbia. The following is a summary of their responses concerning (1) whether radon levels in homes are a problem in their state (2) whether their state certifies, licenses, or accredits companies that perform radon measurements in their state, and if so, the elements included in their program and (3) their states' efforts to provide radon information to the homeowner.

MOST STATES VIEW RADON AS A PROBLEM

Thirty-five of the 51 radon coordinators said they believe radon levels are a problem in their state. Coordinators in the states of Alaska, Arizona, Arkansas, Hawaii, Indiana, Louisiana, Mississippi, Oklahoma, North Carolina, South Carolina, Texas and the District of Columbia said radon was not a problem. Radon coordinators in California, Nevada, New Hampshire, and South Dakota did not know whether radon was a problem in their state.

FEW STATES HAVE ACCREDITATION PROGRAMS

Nine of the 51 state radon coordinators told us that their states have programs to certify, license, or accredit companies that perform radon measurements in their state. The remaining 42 coordinators said that their states do not have such a program. Of the states with programs, five have mandatory programs: Delaware, Florida, Iowa, Pennsylvania, and Virginia. The four states with voluntary programs are Kentucky, Nebraska, New Jersey, and North Dakota. All nine states publish a list of proficient radon testing companies.

Coordinators from 20 of the 42 states that do not have radon measurement accreditation programs expect their states to have programs in the future. Six of the 20 coordinators anticipate having programs within 1 year, 4 others foresee having a program within 2 years, while the remaining 10 expect to establish programs but do not know when. The coordinators for the remaining 22 states without programs do not expect their states to establish programs in the near future. Although these coordinators do not foresee their states establishing a program, 12 of them believe that radon is a problem in their states.

To help defray the cost of the state certification, three states, (Florida, Iowa, and Pennsylvania) are currently charging application fees, and the fourth state, New Jersey, will begin to charge a fee when its state certification program becomes mandatory according to a state official. Iowa is the only state requiring all radon measurement companies to post a bond before operating.

ACCREDITATION REQUIREMENTS VARY IN THE NINE STATE PROGRAMS

We asked the coordinators in the nine states with programs to describe both their requirements for radon testing companies and the state activities that were included in their programs. The number of requirements in the nine programs varied. The only requirement common to all nine programs is for companies to participate in EPA's RMP testing program and/or a similar state-run testing program. Examples of other requirements include the following:

-- Seven of the programs require measurement companies to meet minimum educational requirements for critical personnel.

-- Seven states have established minimum radon experience requirements for a measurement company's critical personnel.

-- Five programs require companies to calibrate their equipment periodically and follow other quality control procedures such as (1) routine checking of equipment accuracy, (2) procedures to ensure that measurement equipment is operating properly, and (3) record keeping.

-- Four programs call for on-site inspection of measurement companies.

The following table compares the requirements of the nine state programs.

Table I.1 Comparison of Program Requirements

State program requirements	Mandatory program					Voluntary program				Total
	FL	PA	DE	VA	IA	NJ	NE	ND	KY	
Companies required to participate in EPA's RMP testing program and/ or state-run testing program	X	X	X	X	X	X	X	X	X	9
Minimum education required for critical company personnel	X		X		X	X	X	X	X	7
Minimum radon experience required for critical personnel	X	X	X		X	X	X		X	7
Companies required to submit radon test results	X	X	X		X	X			X	6
State program includes radon training for measurement companies	X				X	X	X	X		5
Companies required to calibrate their equipment periodically	X	X			X	X			X	5
Other quality assurance procedures required ((1) routine checking of equipment accuracy, (2) procedures to ensure that measurement equipment is operating properly, and (3) record keeping)	X	X			X	X			X	5
State program calls for on-site inspection	X	X			X				X	4
Companies and radon specialists required to pay a fee	X	X			X					3
State program includes blind testing of companies		X								1
Companies required to post a bond					X					1

STATE EFFORTS TO COMMUNICATE WITH HOMEOWNERS

We asked state coordinators to furnish information on the ways their states communicate with homeowners. All states have some means of communicating indoor radon problems to the public. The

following list summarizes the different ways states are providing radon information to homeowners:

-- 19 states have a radon hotline.

-- 50 states distribute EPA's Citizen's Guide for Radon.

-- 48 states distribute listing of proficient radon measurement companies.

-- 49 states distribute other radon brochures/publications.

-- 3 states run television, radio, or print ads.

-- 32 states use other outreach methods to provide consumers with radon information.

FUNDING FOR STATE RADON PROGRAMS

While 32 states provide some funding for radon activities, only 18 have designated money specifically for radon programs in the state budgets. The remaining 14 states use funds from larger departmental budgets. As shown below, the amount of funds budgeted for radon varied among the 18 states:

-- Four states budget over $1 million for radon (Florida, New York, Pennsylvania, and New Jersey).

-- Five states budget between $100,000 and $1 million (California, Washington, Connecticut, Alaska, and Illinois).

-- Six states budget less than $100,000 (Maryland, Iowa, New Hampshire, Wisconsin, Indiana, and Idaho).

-- Three states did not tell us their funding levels (Kentucky, Minnesota, and Tennessee).

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Before the Senate Committee on Environment
and Public Works

Statement by the
American Association of Radon Scientists
and Technologists (AARST)

On Federal Legislation to assist in the
reduction of human exposure to radon in
school and any real property which is owned
by any agency, department, or instrumentality
of the United States.

Presented by
Marvin 'D' Goldstein
Co-Chairman
Legislative Committee
American Association of Radon
Scientists and Technologists (AARST)

Radon is by far the largest indoor environmental health risk this nation faces today. The risk of lung cancer due to radon exposure is well documented by animal studies, uranium miner data and recently by the case control study of radon and lung cancer among New Jersey women. New data allowed the EPA to recently upgrade the total amount of predicted deaths due to radon from 20,000 a year to 21,400. This month a study published in the prestigious British Medical Journal, The Lancet, linked radon to other cancers such as leukemia, brain, bone and skin cancer in both children and adults. The average direct cost of treating a single victim of lung cancer in the United States is estimated to be $42,876.00 a year. This adds up to almost a billion dollars a year for the 21,400 new radon induced lung cancer cases. If you calculate all the indirect costs, the figure jumps to six billion dollars a year. These costs place an incredible strain upon our economy for directly delivered medical services. We can, however, do something to lower the risk and lower the cost of this tragic disease.*(A)

The EPA has identified acceptable methods to test for radon, and an entire industry of skilled professionals is available to meet the need. The techniques and costs for remediating buildings is also known and is comparatively inexpensive. Members of the American Association of Radon Scientists and technologists are available to inspect houses in every state of the Union. AARST members have invested millions in the latest radon testing and mitigation technology and training. AARST members have the demonstrated capacity to meet any and all future needs for radon inspection and mitigations that may result from pending legislation. If anyone needs qualified inspectors or mitigators at affordable prices contact AARST and we will supply you with many names of qualified individuals and companies to test and mitigate radon hazards in your area. The EPA has not been able to convince the American public of the seriousness of this threat. The public is neither testing their houses, nor their places of employment. How many of you have actually tested your own house?

*(A)Oster, Coldits and Kelly, Economic Costs of Smoking and the Benefits of Quiting (D.C. Health and Co., 1984). The authors calculated the total annual costs of care for the first year after the onset of lung cancer to be $22,000.00 in 1980 dollars. Given a 7.5 annual increase in medical costs since 1980 that first year cost in 1990 is about $42,876.00. Total costs including both direct and indirect costs are about an order of magnitude larger. These figures have been recently confirmed by the American Cancer Society; Sandra Smith RN, MSN and Oncology Nurse Educator.

The American Association of Radon Scientists and Technologists (AARST) supports S 1697. However, we feel that it should be mandatory that every school in the United States of America be tested for elevated Radon levels. The EPA administrator recommended that every house in the country be checked for elevated radon levels and certainly we should not have a lesser standard for schools. We recommend that those schools tested at over 100 pCi/l be given remediation grants of up to 50 percent of the total cost of testing and mitigation. Those schools testing under 100 pCi/l be given loans of up to 100 percent of the total cost of a testing and mitigation program.

AARST further recommends that only companies and individuals that passed the EPA's Radon Measurement Proficiency Program be permitted to conduct the testing. And that only radon measurement devices and methods in which over 75% of the individuals and companies using them passed the EPA's RMPP be permitted.to be used.

Congress, in evaluating the risk from radon, did not set a goal of reducing radon to the EPA's action level of 4 pCi/l. Rather, they saw the enormity of the risk and enacted a law that states that our national goal is to lower indoor radon levels down to the average outdoor level of 0.2 pCi/l which is 1/20th of EPA's action level. The Department of Defense has responded to the risks and is now testing residence facilities at military bases throughout the world. The General Services Administration has also responded to this health risk and is testing all Federal office facilities.

The Stewart McKinney Homeless Assistance Amendments Act of 1988 (Public Law 100-628- Nov. 7, 1988) required: "The Department of Housing and Urban Development to develop an effective departmental policy for dealing with radon contamination...to ensure that the occupants of housing covered by this section are not exposed to hazardous levels of radon." HUD was clearly ordered to respond, as the Act stated..."The Secretary shall submit a report to Congress within 1 year after the date of the enactment of this Act that describes the Secretary's recommended policy for dealing with radon contamination and the Secretary's reason for recommending such policy."

*(B)There are approximately 250 million Americans. The McKinney Act applies to approximately 3 million units of low income housing. Assuming an average of four occupants per unit, that would result in a total of 12 million occupants, which is 5% of todays population of the USA. Five percent of the 21,400 Radon induced lung cancer deaths equals 1,070 lives lost per year.

It is now six months after the McKinney deadline and HUD has still not presented a radon policy. Members of the committee, there are approximately three million McKinney act housing units. Assuming there is an average of four occupants per unit, we are referring to 12 million people, or five percent of the population of the United States. Using EPA's own statistics estimating deaths related to radon, that translates into over 1,000 deaths a year.*(B) HUD's inaction; which imperils the lives of so many people each year, should be considered a bureaucratic disgrace. These are low income citizens without the money to test for radon and correct the problem themselves. Clearly HUD has not responded in compliance with the Congressional mandate. There is a serious potential legal liability because the Federal Government knows the magnitude of this risk and its own responsible agency has not responded to its mandate. Almost three people a day are dying of radon induced lung cancer in McKinney Act Housing. For every day HUD delays its implementation of the Congressionally mandated Radon Program for McKinney Act Housing, their potential legal liability grows.

It has been estimated that the implementation of the Clean Air Bill will result in a cost of 16 million dollars per life saved. If all of the McKinney Act housing units were tested and mitigated, the cost is estimated to be only 6 thousand dollars per life saved. This radon program could be 1,000 times more cost effective at saving lives than other measures already enacted by Congress to control air pollution.*(C)(D)

I reiterate the specific threat posed by radon gas is the largest single indoor environmental health danger known to exist. It is simple to measure and easy to fix. The public is not responding on its own. Thousands of lives and billions of dollars in health care costs are at stake and could be saved if testing and remediation were made manditory practices.

It is urgent that we act promptly to act responsibly. A minimum exemplary action would be to mandate that all Federal buildings and Federal Agency buildings sold or otherwise transferred to private ownership or custody must include a radon test and reduction of elevated levels. This would not only save lives but, it should set an example for the nation to follow. The Federal Government should set an example if it expects the public

*(C)Forbes Magazine (April 30, 1990 Page 161)

*(D)Assumung it costs 300 million dollars for radon testing and remediation, and that there are 1,000 lives saved per year at a 50 year life expectancy of buildings we can conclude that $300 million divided by 50,000 lives saved equals $6,000.00 per life saved.

to respond to the radon threat. Congress should follow through on the mandate that the Federal Government test its own buildings by testing all Federal Agency owned and leased buildings. In my opinion the Federal Government should never be involved in the ownership or transfer of any real estate that can subject the occupants to this death risk.

Congress should require that all Federal buildings and Federal Agency owned buildings be tested for radon and that elevated levels be reduced to acceptable levels. Congress should mandate that HUD not only fulfill its obligation to develop a radon plan, but that the plan must include immediate radon testing and reduction of elevated levels for all of its McKinney Act housing units.

The Federal Housing Administration (FHA) each year repossesses and sells about 87,000 family housing units. These Federal Agency owned units should be tested for radon and elevated levels reduced before the units are sold to the public. Congress should also mandate that all future FHA and VA and Farmers Home Administration insured loan assistance require radon testing and reduction of elevated levels, so that the occupants of these buildings could literally breathe easier.

Finally, Congress should mandate that the EPA adopt standards for testing during a real estate transfer to ensure that appropriate testing techniques and equipment are used. The EPA should also be empowered to implement a program of certification of testers and the technical equipment used in radon measurement. It is estimated that up to 30% of all radon tests conducted for residential real estate transactions are subjected to tampering. Federal laws prohibiting tampering and requiring certification of the testers are two ways to reduce this potential fraud.

In conclusion, let me state that there now exists an opportunity for the Congress to truly save lives and to reduce the future cost of a health system that has become a huge burden to society. We urge you to seize the moment and generate the needed legislation.

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AMERICAN LUNG ASSOCIATION®
The Christmas Seal People®

May 21, 1990

Dear Mr. Chairman:

The American Lung Association was invited to testify on May 18, 1990, at the hearing on radon in the schools. We are unable to be present at the rescheduled hearing due to the World Conference on Lung Health being held in Boston, Massachusetts.

I am submitting a copy of William A. Turner's testimony, for the record, on behalf of the American Lung Association concerning radon in the schools.

Sincerely,

Fran Du Melle

Fran Du Melle
Director
Office of Government Relations

STATEMENT OF

WILLIAM A. TURNER, P.E.

ON BEHALF OF

THE AMERICAN LUNG ASSOCIATION

TO THE

SUBCOMMITTEE ON SUPERFUND, OCEAN AND WATER PROTECTION

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

RE: RADON IN THE SCHOOLS

MAY 18, 1990

Mr. Chairman and members of the Subcommittee, I am William A. Turner, P.E., manager of the Building Air Quality Group at Harriman Associates, Auburn, Maine. I serve on the Board of Directors of the Maine Lung Association and today am presenting comments on behalf of our national organization, the American Lung Association.

The American Lung Association is the nation's oldest voluntary health organization and is dedicated to the prevention and control of lung disease. The American Lung Association, with its medical section, the American Thoracic Society, has long recognized the contribution of air pollution, both indoors and outdoors, to the development or exacerbation of lung disease.

The subject this morning is indoor air pollution, specifically, the exposure of children and staff to radon and its decay products in schools. While many health effects of indoor pollutants remain controversial, radon exposures in schools--which in some cases have been found to exceed worker exposures in the uranium mining industry--clearly represent an unnecessary risk for our children.

The Subcommittee has previously received testimony on behalf of the American Lung Association from Dr. Philip Bromberg, Director of the Center for Environmental Studies at the School of Medicine, University of North Carolina, Chapel Hill detailing the general health effects of indoor air pollution. Therefore, I will focus my comments today on the

issue of radon exposure in schools.

Radon is estimated to be the second leading cause of lung cancer in the United States today--cigarette smoking remains the primary cause. The Environmental Protection Agency estimates that 20,000 lung cancer deaths each year may be attributed to exposure to high levels of radon indoors. A 1988 report by the National Research Council of the National Academy of Sciences found that smokers exposed to radon increase their risk of lung cancer by ten times or more in comparison to nonsmokers. Regardless of the radon level, the longer the period of exposure, the greater the health risk.

We have known for a number of years that the possibility exists throughout many areas of the United States for homes to have elevated radon levels caused by the entry of naturally occurring soil gases. Only in very recent years, through the efforts of the Environmental Protection Agency's Office of Radiation Programs, and state and local agencies, have we begun to evaluate the radon exposures which may occur in our schools.

Through my involvement, during the past year, with the Environmental Protection Agency's School Evaluation Program, I have personally had the opportunity to visit seventeen of the numerous schools around the country which have been identified, in initial pilot surveys, as having elevated radon levels. Based on this work, there is a

specific concern which I would like to bring to your attention regarding differences between schools and homes, and therefore the exposures of the occupants.

In the course of evaluating the causes of elevated radon levels which have been measured in these schools, one problem was identified which has been both surprising and alarming to many of us. Many of the schools visited were found to have inadequate ventilation.

Unlike homes, which in general have low occupant densities and therefore, low ventilation rates, schools have been historically designed, by law, to provide significant quantities of filtered outside air to those indoors during periods of occupation in order to dilute body odors and reduce the transmission of disease. Thus, adequate ventilation should be expected to play a far more important role in keeping radon levels in schools at low levels during occupied periods than in homes.

However, as noted in two recent papers presented by myself, colleagues, and officials from the Environmental Protection Agency's Offices of Radiation Programs and Research and Development, this is not always the case. The papers, The School Evaluation Program and The Effects of HVAC System Design and Operation on Radon Entry Into School Buildings, were presented at the 1990 International Symposium on Radon and Radon Technology in February and are attached to my statement. *

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*The papers referred to have been retained in committee files.

- We have observed that the ventilation systems in these schools have either been modified or partially disabled so that the building ventilation rate no longer meets recommended guidance in over 75 percent of the 17 schools initially surveyed. In some of the cases the ventilation system had virtually been turned "off".

- The observed and reported cause of these situations of inadequate ventilation has either been neglect, building modifications that unknowingly reduced ventilation, or abandonment of systems due to perceptions of prohibitive operational costs.

This finding is of significant concern to the American Lung Association. Adequate ventilation must be provided in schools if we are to provide a healthful learning environment for our children. We cannot expect our children and educators to function effectively in sealed boxes of stale air. Many proven technologies exist today which allow designers to provide ventilation in an energy efficient manner.

The American Lung Association continues its strong support for increased research and demonstration efforts aimed at the evaluation and mitigation of indoor and outdoor air pollution. This is especially true for radon exposure in our school populations. For this

reason, the American Lung Association, in particular, supports the programs for radon mitigation in the schools as outlined in S. 1697, The Radon Testing for Safe Schools Act.

The American Lung Association would recommend that in the course of the administration of funding for mitigation, that high priority be given to the use of energy efficient ventilation systems in schools which are demonstrated to have "inadequate ventilation", as well as elevated radon exposures.

The use of energy efficient ventilation systems in schools, which can be operated and maintained with minimum expenditures, should be expected to provide health benefits in addition to reduction of the radon exposures, through the reduction of exposures to other contaminants that originate indoors.

The American Lung Association also recommends in section 10, "Authorization", subsection (b), Mitigation, the expansion of the annual budget resources available for mitigation if need is demonstrated by the results of measurements and response to the program.

In summary, Mr. Chairman, S. 1697 creates a program that is scientifically sound and a reasonable approach to identifying and mitigating elevated radon levels in our nation's schools. There is sufficient agreement on the risk of exposure to elevated levels of radon

and its decay products in schools that federal intervention and assistance can no longer be avoided. As we have advised about both indoor and outdoor air pollutants, we cannot wait for all of the answers before we take action--the American people, and the users of the American school system deserve a safe and healthful learning environment. The American Lung Association believes that prudent public health policy requires adoption of the type of program called for in S. 1697.

Thank you.

PRESENTED AT THE 1990 INTERNATIONAL SYMPOSIUM ON RADON AND RADON REDUCTION TECHNOLOGY - FEBRUARY 19-23, 1990 IN ATLANTA, GEORGIA

D-IX-7

THE SCHOOL EVALUATION PROGRAM

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ABSTRACT

A pilot program to provide classroom and field training to school facility operators was implemented by the U.S. Environmental Protection Agency's Office of Radiation Programs in 1989. This program consisted of two phases. The first phase developed and delivered a three-day workshop in Nashville, Tennessee. As a result of the workshop a second phase was initiated. The second phase investigated several school buildings with elevated indoor radon levels in the Western United States. Radon entry mechanisms were identified. Measurements to evaluate soil depressurization as a radon control method were made and HVAC systems were characterized. Measurements were made to evaluate HVAC modification as a radon control method. Building shell tightness measurements were made and information was collected to judge the suitability of potential sites for additional EPA sponsored "hands on" school training. Physical and institutional problem areas were identified.

This paper has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for presentation and publication.

I. INTRODUCTION

In response to an emerging need for information on the mitigation of elevated levels in United States schools, the Office of Radiation Programs, Radon Division embarked on a limited program to provide technical assistance for building facility managers of school systems. This program, called the School Evaluation Program (SEP) is an extension of an earlier state technical assistance and training program, the House Evaluation Program (HEP), which focused on residential indoor radon.

The goal of the SEP is to develop and implement a technology transfer program which will provide state of the art technical assistance on large building diagnostics and mitigation techniques to school officials and private sector contractors. It is anticipated that EPA's Regional Training Centers will be the vehicle for such a transfer program. Information already collected and currently being gathered by EPA's Radon Division and the Radon Mitigation Branch of the Office of Research and Development, Air and Energy Research Laboratory will serve as the resource base for the SEP.

For Fiscal Year 1989 six schools were investigated and are reported on in this paper. Approximately fifteen additional schools will be visited in 1990 afterwhich a few pilot technology transfer training programs will be field demonstrated. SEP training programs are expected to be made available for delivery by the Regional Training Center in the fall of 1990.

II. INVESTIGATION OF SCHOOLS

Investigations were made in six school buildings. Three were located in Spokane, Washington (designated S1, S2 and S3) and three were located in Los Alamos, New Mexico (designated LA1, LA2, LA3). All of these buildings had been tested for indoor radon and found to have elevated levels in at least some of the rooms. The radon levels in each measured room are shown in Figure 1. As in previous work done in schools by Air and Energy Engineering Laboratory the investigation included characterizing the building structure, subslab characteristics, HVAC effect on air pressure differential across the building shell and radon entry (1). Additionally, in this effort information was collected on the building shell tightness, the operational status and control strategy of the HVAC equipment and airflow rates of ventilation equipment.

III. RADON ENTRY

All of the schools were slab on grade construction. The major penetrations through the slabs were the joint at the edge of the slab and water pipe penetrations. In school LA1 there were two laboratory rooms that had trenches containing sink drains covered by steel plates. The lines drained into a sump pit, also covered by a steel plate. Not much radon appeared to enter from these trenches. One school (LA2) had a trench that is

used as an air supply and another (School S2) a return. The wing of LA2 that had supply air ventilation through the trenches also had low radon concentrations in the rooms. It is unknown whether this is from supply air pressurization or lack of a radon source. The return air trench in the gym ventilation system of S2 was contributing radon to the school air whether it was operating or not. Measurements made in the trench revealed radon concentrations of about 60 pCi/L. The radon concentrations beneath the slabs of schools S1, S2, LA1 and LA2 were measured. The results are shown in Figure 2, along with a summary of the HVAC equipment in the schools. As can be seen they varied from a low of 400 pCi/L to a high of 1,300 pC/L. While high compared to all but the most extreme cases of indoor levels these are relatively low subslab concentrations for buildings with elevated radon. They are typical of residential buildings with permeable soils (sands and gravels). (Figure 2 summarizes the radon levels in all the schools).

SOIL DEPRESSURIZATION TESTS

In order to assess the potential for radon control by soil depressurization, a vacuum suction test was made [illegible]hools S1, S2, LA1 and LA2. The results were encouraging for LA2 (stone [illegible]s beneath the slab, suction <30 feet) and LA1 (sand and gravel beneath [illegible]slab, suction <28 feet), not as encouraging for S2 (coarse sand beneath the slab, suction <20 feet) and discouraging for S1 (fine sand beneath the slab, suction <15 feet). Figure 3 shows the suction versus distance curves for LA1 and S2. Notice that the pressure field decays exponentially with distance from the suction point. A possible explanation for this is that in fine materials the flow exponent is nearer .5 than 1, resulting in a nonlinear function.

An interesting observation was noted during the vacuum suction test in school S2. The first time the vacuum test was performed no pressure field was developed under the slab even 8 inches away from the suction point. The vacuum could not compete with the suction (minus 28 pascals) put on the building by the exhaust fans and soil air was still entering the school through the test holes. By opening an outside air vent and one window in each room the negative pressure across the building was far smaller (minus 2 pascals). Under these conditions it was possible to extend a pressure field that was nearly 1 pascal at 30 feet and 2 pascals at 12 feet by exhausting 28 cfm at 18 inches WC from beneath the slab. Additionally the pressure field extended from room to room and across the corridor into rooms on the opposite side. This is rather encouraging for soil depressurization if the negative pressure in the building can be controlled.

IV. HVAC CHARACTERIZATION

The HVAC systems in all six buildings were characterized in terms of heating and cooling, ventilation types, control strategy, and the potential impact on radon levels. The ventilation systems in four of the six schools were primarily individual exhaust fans with only a small amount of either powered supply air or outside air. In the two schools that did have powered

supply air, S3 and LA3, the measured indoor radon levels were relatively low. The highest level in S3 and LA3 were 7.3 pCi/L and in LA3 6.4 respectively and 50% of the rooms in each school were below 4 pCi/L. Both of these buildings have air supply systems in which the outside air damper position is controlled by the need for cooling with in the building (economizer type systems). For this reason it is expected that the amount of outside air being supplied is dependent on occupancy status. Therefore a screening measurement made on a weekend with a weekday schedule, but unoccupied status may not be representative of the actual occupied radon levels (see the details of investigation in S3). The HVAC features are summarized in Figure 2.

One of the prominent features of the HVAC systems was the number of problems found. These problems covered a range that included inoperative equipment (broken belts, fans, controls), poorly maintained equipment (disabled damper linkage, dampers painted shut), poorly designed equipment (ventilators too small or not used because they are too noisy and there is individual control within classrooms) and unwitting modification of the ventilation system (replacing the rolled steel sash window walls with insulated wall). The extent to which these types of problems were present was remarkable. Every school visited suffered from at least one of these problems. The following summarizes them for each school:

S1 Ventilation capacity lower than present ASHRAE guidelines of 15 cfm per student. Make up air damper closed. No ventilation system was found in the graphics room. Because this is an area where a number of indoor air contaminants are produced, ventilation should be suggested to the building owner.

S2 Too little outside make up air in school design. The only ducted outside make-up air into the school was inoperative (broken control).

S3 Heating, cooling and ventilation are supplied by a Variable Air Volume (VAV) system housed in the third story mechanical room. There are local exhausts in the lavatories, gym and kitchen. Even though this is a modern, sophisticated system, one of the exhaust air blowers was inoperative due to a broken belt.

LA1 Rest room fan has a broken belt. All but one of the previously operable small windows on the south wall of the library were sealed with caulk, leaving a single operable window as the total ventilation capacity.

LA1 Annex has a damaged gravity type relief opening which originally appears to have been a large exhaust fan. Of 10 unit ventilators observed only 5 showed any outside air flow when operated, many had the outside air intakes sealed closed.

LA2 Southwest Addition The ventilation feature of the unit ventilators has been abandoned and many of the blower motors are no longer operational. Core area's rooftop relief vents with pneumatically actuated dampers could not be made to operate by school personnel. The majority of rooftop fans were

found to be operable only after the rooftop disconnect switches were turned on and a loose fuse was tightened. Northeast Addition Linkage controlling the outside air damper disconnected. A large rooftop exhaust fan inoperative. A strong odor of mold was noted in the south end of this addition. Mold growth covers the exterior insulation material in the mechanical room. Mechanical room unit heater inoperative.

LA3 School officials report unit ventilators often turned off by room occupants (complaints of noise). Most outside air intake manual dampers (located on the roof office area unit) were in the closed position. The ventilation feature of some units were abandoned or not utilized. Short circuiting was observed in the outside air intakes of unit ventilators causing room air entrainment into the make up airstream at roof penetration.

V. BUILDING SHELL TIGHTNESS

The tightness of the building envelope was estimated by depressurization techniques in three of the schools investigated. They were the S1, S2 and LA1. This type of measurement had been made in only a small number of large buildings and only in one school (the one school previously measured was part of the ORP school work done in 1988 and was located near Albany, New York). Other researchers have made similar measurements in a small number of buildings, Shaw in eight (2, 3) and Persily and Grot in seven (4). Most of the results from these buildings are reported by Persily and Grot in the paper "Pressurization Testing of Federal Buildings" in the ASTM Special Technical Publication 904, "Measured Air Leakage of Buildings". In this paper Persily presents two methods for comparing the tightness of one building to another.

The first compares the air exchange rate at an induced air pressure difference of 25 pascals (see Figure 4). It can be seen that the schools studied span the range of building tightness reported by Persily for the Federal office buildings. Two of the schools are substantially leakier than the office buildings and S1 is the tightest building measured. This represents a large range of building shell tightness for schools.

In an effort to account for surface to volume ratio differences, the second method normalizes the airflow rate at 25 pascals to a unit area of exposed envelope (see Figure 4) the office building data again from Persily (4). Notice that there is a larger range of values for this index of building tightness and that the ranking of the building is somewhat changed. Problems with this method may occur if the flowrate at 25 pascals is normalized to the exposed wall area rather than the exposed envelope area. This is because roof area is a small fraction of envelope area for high rise buildings and a large fraction for low rise buildings.

A third method of comparing building shell tightness is to calculate an Effective Leakage Area. The method used here is to calculate the leakage area at a pressure differential of 4 pascals according to the method developed by Grimsrud and Sherman at Lawrence Berkley Laboratories (LBL) (5). The results

of these calculations are shown in bar chart form in Figure 5. The schools fall within the range of ELA's calculated for the office buildings. These range from 414 square inches to 14,133 square inches.

A fourth effort to interpret the building shell tightness measurements compared air exchanges at 25 pascals to air exchanges measured using tracer gas measurements. Analysis was performed on the three schools measured in the SEP so that they could be compared with the office buildings reported by Persily and the Albany school reported by Brennan. Figure 6 is reproduced from Persily (4) and shows measured ventilation rates versus ACH at 25 pascals for the office buildings studied. While there is a fair amount of scatter in the data a relationship is apparent. Using this as a guide the infiltration rates for the three schools when mechanical ventilation is not in operation can be estimated to be .07 ACH for S1, .15 ACH for S2, .51 ACH for the Albany School and .7 ACH for LA1. These are very rough estimates of the infiltration rates in these buildings. However, they can be compared to the installed power ventilator capacity of .07 ACH for S1, .57 ACH for S2, 1.1 ACH for the Albany School and .79 ACH for LA1. It is obvious from these values that naturally powered ventilation plays an important role in the ventilation rate of schools.

VI. RECOMMENDATIONS

In each of the school buildings both a soil depressurization and an HVAC approach to controlling indoor radon levels were addressed. An HVAC system approach was considered to be the first choice in four of the schools (S1, S2, S3 and LA3). In LA1 and LA2 a soil depressurization system is suggested in conjunction with an HVAC approach. Unlike the work reported by Saum et al. (6) this program found only one building with stone pebbles beneath the slab. Most of the schools investigated had fine sands under the slabs and would require numerous suction points to establish a low pressure field beneath the entire slab. This severely limits the application of soil depressurization as a first choice control technique.

Note: It is important that any approach that is used in school buildings comply with state requirements for qualifications in the design and installation of mechanical systems. Any HVAC work should involve a professional engineer experienced in air handling systems and their interaction with the building shell.

In S1 HVAC modification was the first choice because the ventilation system did not meet current recommended ventilation guidelines, the building is tight enough to pressurize with the appropriate amount of ventilation air and the results of the vacuum suction test were very discouraging (many suction points would be needed).

In S2 HVAC modification was the first choice because the exhaust only ventilation depressurized the building to such an extent (minus 28 pascals) that the vacuum suction test would not work against the exhaust fans. HVAC

supply must be addressed in order for soil depressurization to work at all, at which time the radon levels may well have been dramatically lowered. So a soil depressurization method is a second, but possible approach. If implemented it would take 1 suction point for each affected room.

In S3 HVAC adjustment is recommended because it is an economical, straight forward process. The probability of this approach working is considered high because the building is already under positive pressure with all the exhaust fans on and that, the room with the highest screening measurement (unoccupied) 7.3 pCi/L, averaged 1.6 pCi/L for 38 hours when normally occupied and less than 1 pCi/L for the occupied time alone (7 hour school day).

In LA3 HVAC repair and operation is suggested as the first choice because the relatively low radon levels, the presence of closed or short circuiting outside air dampers (levers locked in place with canned foam), and a control system that opens outside air dampers on an economizer cycle indicate a high chance of success.

In LA1 a combination HVAC and soil depressurization approach is suggested because the radon levels are high in each room and because the highest rooms are between 20 and 40 pCi/L. This means that an HVAC approach would have to pressurize the building. It would take 20,000 cfm of supply air to do this when each exhaust blower was on. If the exhaust blowers were all eliminated except in the areas of pollutant generation (bathrooms, chemical storage rooms, maintenance closets and science laboratories) then the building could probably be pressurized with 12,000 cfm of supply air. This approach is not out of the question. Soil depressurization is suggested because of the difficulty of pressurizing this building and the somewhat encouraging results of the vacuum suction test. It would still take 16 to 17 suction points if all the rooms need to be treated. So the suggestion is to modify the HVAC system with every effort made to pressurize the building. It is likely that this approach will not successfully lower all the rooms and that one suction point will have to be used in each affected room. If the soil depressurization approach is tried before the HVAC approach it will take 16 to 17 suction points.

In LA2 a combination HVAC and soil depressurization approach is suggested. The soil depressurization method would almost certainly reduce radon in the affected rooms with one or possibly two suction points, one in room 6 and another in room 2. However, there are so many inoperative components in the school ventilation system (fans, dampers and controls) as well as an obvious fungus problem that it is felt that the entire ventilation system should be evaluated, repaired and amended to provide acceptable ventilation according to ASHRAE Guidelines.

VII. CONCLUSIONS

DIFFICULTIES WORKING IN SCHOOLS

There are a number of areas that make controlling indoor radon in schools more complex than in residences. It begins with screening measurements. Radon levels in buildings can be affected by the operation of the mechanical systems. This is more complicated in schools than in houses because the mechanical systems and their control systems are more extensive and complex. This difference is most important in the ventilation system. Many residences have ventilation systems that consist of natural infiltration and exhaust fans in bathrooms and kitchens. Each exhaust fan is rather small and operated by the occupant, not a central control. The ventilation systems in schools fall into one of the following types:

- o Exhaust Air consisting of:
  - individually controlled fans
  - centrally controlled fans or pressure relief hoods.

- o Outside Air entering:
  - through leaks in the building shell (often rolled sash windows)
  - centrally controlled Unit Ventilator dampers
  - centrally controlled outside air dampers
  - centrally controlled supply fans
  - individual controlled Unit Ventilator dampers

Problems arise when the operation of the ventilation system could affect the indoor radon concentration and the control of the ventilation system is not easy to characterize. For example, a school that has individually controlled exhaust fans (e.g. nine fans delivering a total of 8,832 cfm in the core of LA1) and makeup air supplied by leaks in the building shell. It is difficult to identify a normal operating pattern when exhaust fans are controlled by a variety of individuals. Differing operational and occupancy combinations may result in different radon concentrations. It is presently unclear as to how to interpret time integrated measurements.

Another example. A school with centrally controlled exhaust and supply (e.g. S3 has a VAV system and other schools have Unit Ventilators) often has the outside air dampers controlled with an economizer cycle that opens the dampers in response to outside temperature and cooling load. This means that in the spring and fall months the occupied building has far more outside air than the unoccupied building. Screening measurements made in unoccupied buildings are not as representative even though the HVAC timing schedule is the same as for the weekday. Time integrated radon measurements made when ventilation rates depend upon occupant status can be difficult to interpret.

A second difficulty is with the shear size of the buildings. Indoor and subslab radon measurements sampled in only a few areas probably do not

represent even the average values much less establishing the range of values. In large buildings HVAC characterization alone can take more than a day.

A third difficulty is that design and installation work in schools is regulated in most states. Often this regulation includes minimum educational and experience qualifications of installers and designers, permits and/or inspections by State and/or local officials. The regulation is designed to protect the public from health and financial risk in the design, construction and operation of schools. As this applies to radon control with HVAC systems the important points are that the system actually perform its functions of conditioning the space and supplying adequate ventilation while at the same time controlling radon. Additionally the building as a system must maintain an appropriate fire control rating to protect against life loss and injury in the event of fire.

Lastly, the design and installation of new HVAC systems or major modification of existing HVAC systems are time consuming, disruptive and costly. However, these should not be considered obstacles when the existing HVAC system is failing to meet the primary goals of comfortable conditioned space with acceptable air quality. A system that does not supply adequate ventilation because it is not operated, is operated improperly, has been changed or is in need of repair is not performing its function and should be repaired, modified or replaced in accordance with State and local codes and regulations. This may require a financial procurement and design and installation process that will take some time to complete. In these cases it is suggested that a good short term response to extremely elevated school room radon problems could be soil depressurization systems which can sometimes be designed and installed for a much smaller budget on a more streamlined timeframe (often less than a week for the installation). Some school systems have undertaken this type of radon control as ordinary maintenance operations.

VIII. QUESTIONS RAISED

There are important questions about radon measurement and control in schools that have been raised.

- How can population exposures be estimated from time integrated measurements?
- What effects on indoor radon levels are engendered by the operation of HVAC systems, the control strategies of HVAC systems and the occupied status of the building? Are these effects important?
- What do indoor radon measurements mean in a building that does not meet recommended ventilation guidelines or has a ventilation system that is wholly or partially disabled either by neglect or by building modifications that unknowingly after the ventilation system (closing off rolled sash window walls)?

- How can indoor levels of radon be controlled in schools that have fine but porous soil beneath the slab and are not amenable to building pressurization?

- Must there be a suction point for every room?

A number of these questions are currently being addressed by the EPA ORP School Radon Protocol Development Study and by the EPA Air and Energy Engineering Research Laboratory's School Radon Program but others can only be answered by an increased data base size.

IX. ACKNOWLEDGEMENTS

The authors would specifically like to thank Jerry Leitch of EPA's Region X office and Mike Miller from Region VI for their valuable assistance in participating in the school investigation's and for all the coordination and arrangements made by them to facilitate our visits to their region.

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Figure 1 Radon Levels in School Rooms
Error bars are one stndard deviation

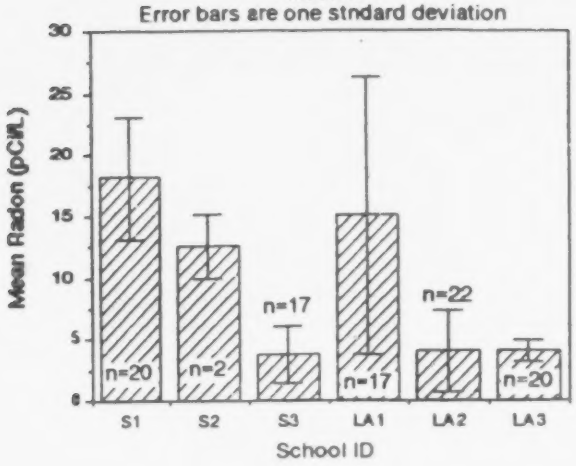


Figure 2 Summary of School HVAC and Sub Slab Characteristics

Sch. ID	Heating	Cooling	Ventilation (cfm) measured Exhaust	Make up	cfm/per.	Control	Sub Slab Material**	Rn pCi/L	Vac. cfm
S1	Warm air	AC	1000	170/OA	10	thermostat/SB	FS	600±200	6
S2	Hot Water	None	5800	Inoper.*	11	thermostat/SB	CS	1100±200	27
S3	Warm Air	AC	NT	VAV		CPU man.	NT	NT	
LA1	Hot Water	None	10000	400/UV	14	thermostat/SB	S&G	500±50	20
LA2	Hot Water	None	NT	None		Thermostat**	SP	900±100	38
LA3	Warm Air	AC	NT	NM/UV	14	Thermstat*	NT	NT	

* the supply damper to the gym system was not working
** an installed enrgy management control had been disabled
* the controls for the Unit Ventilators were in each classroom and teachers reported they didn't operate them because they were too noisy
** FS - Fine Sand CS - Coarse Sand S&G - Sand and Gravel
SP - Stone Pebbles NT - Not Tested

Figure 3 Distance vs. Suction for the Vacuum Suction Test in Two Schools

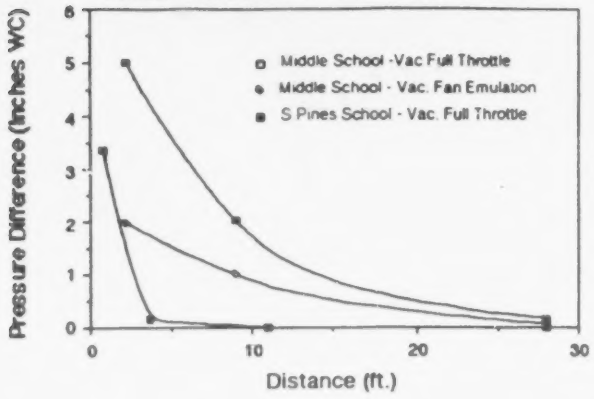
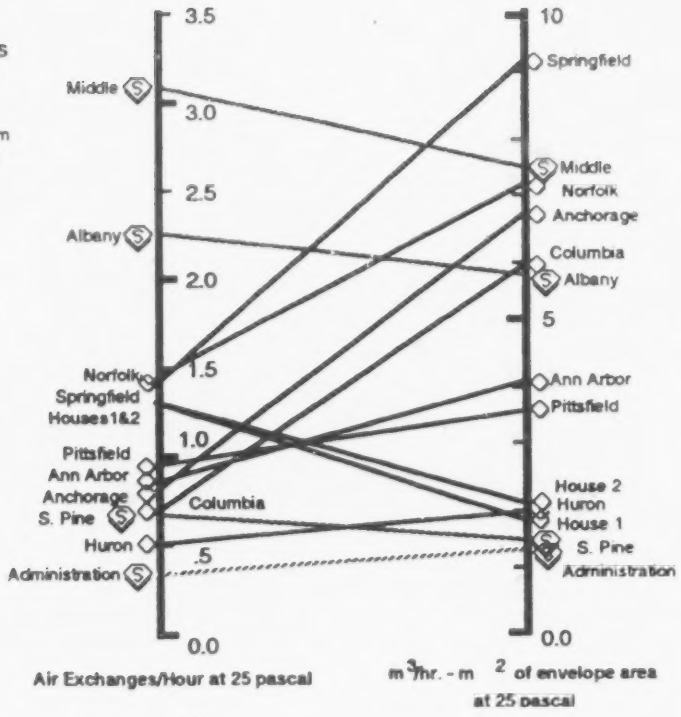
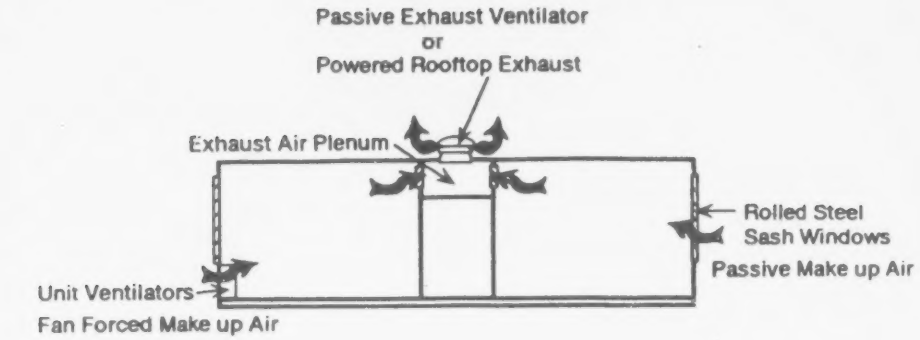


Figure 4
Results of
Pressurization Tests
On Large Buildings

◇ Federal Buildings from NBS (currently NIST) Study(Pe86)

Ⓢ SEP Schools from EPA, ORP





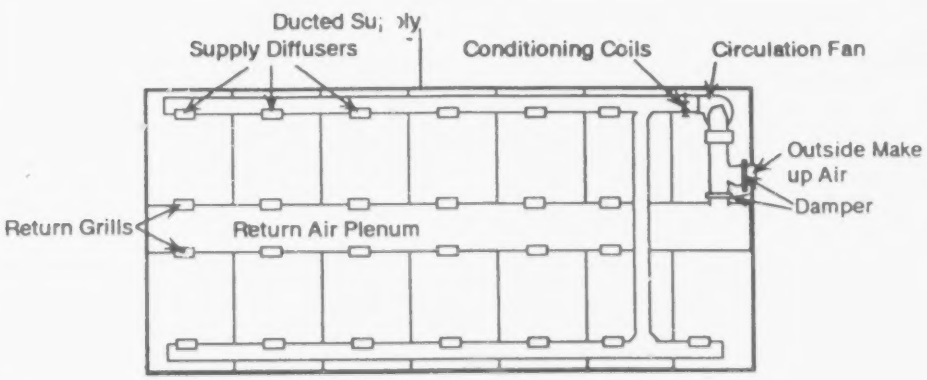


Figure 7 - Types of Ventilation Commonly Found in Schools
Ventilation Consists of Exhaust and Make Up Air

Exhaust	Make Up Air
Centrally Controlled fans or Passive Relief	Air leaks in building
Individually controlled fans	Outside air dampers to returns
	Unit Ventilators
	Make up air fans

In addition there are usually exhaust fans in janitors closets, bathrooms, copy rooms kitchens and science rooms

Figure 5
Effective Leakage Areas of
Office Buildings and Schools

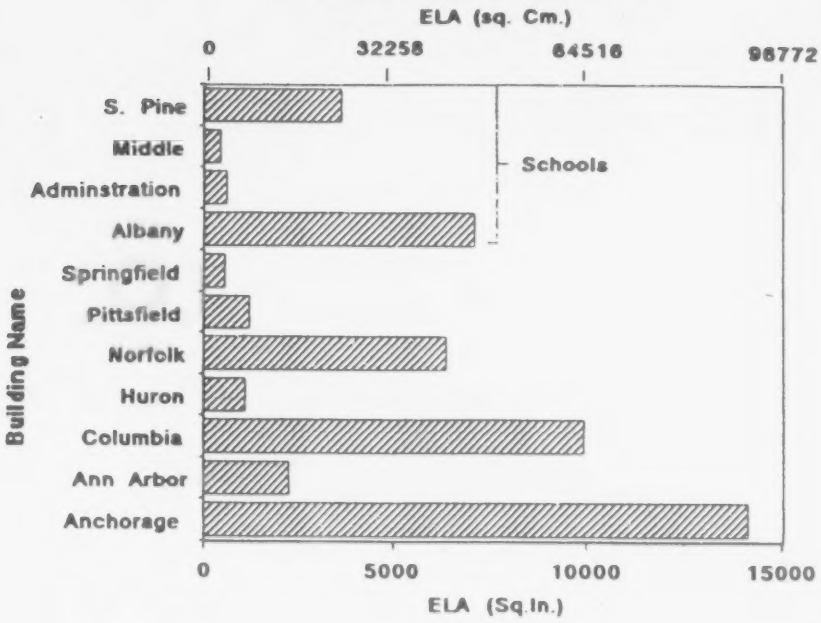
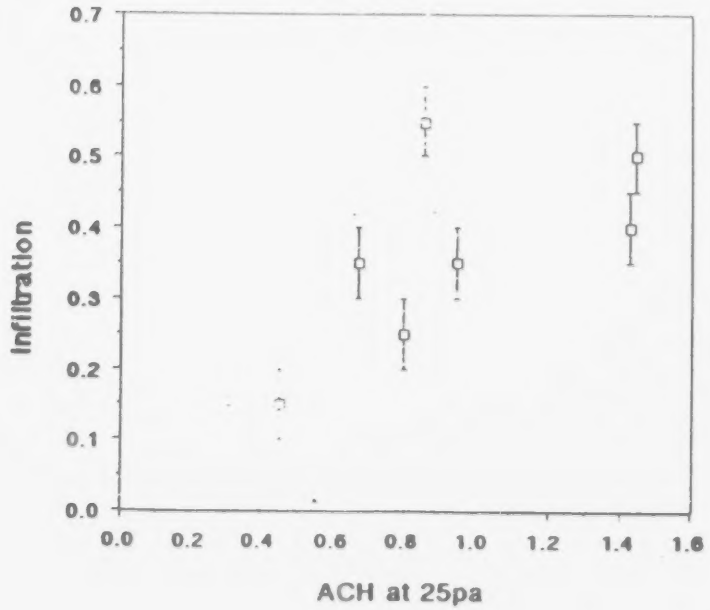


Figure 6
Measured Infiltration vs. ACH at 25 pascals
in Eight Office Buildings (Pe86)



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STATEMENT FOR THE RECORD

on behalf of

THE NATIONAL SCHOOL BOARDS ASSOCIATION

on

RADON TESTING FOR SAFE SCHOOLS ACT

for the

Senate Environment and Public Works Subcommittee on
Superfund, Ocean and Water Protection

June 4, 1990

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I. INTRODUCTION

The National School Boards Association (NSBA) is pleased to submit this statement for the record on the "Radon Testing for Safe Schools Act." NSBA is the only major education organization representing the over 97,000 locally elected and appointed school board members across the nation. Currently marking its fiftieth year of service, NSBA is a federation of state school board associations with direct local school board affiliates, constituted to strengthen local lay control of education and to work for improvement of education. Nationwide, local school board members are politically accountable to their constituents for the prudent operation and fiscal management of the local school districts they serve. As government officials, school board members are uniquely positioned to judge federal legislative programs purely from the standpoint of public education, without consideration to their personal professional interest.

II. BACKGROUND

On September 28, Senator Frank Lautenberg introduced the "Radon Testing For Safe Schools Act" (S. 1697). The proposed legislation would impose significant new requirements on local education agencies, state governors and the Environmental Protection Agency (EPA).

If enacted into law, the bill would require EPA to both promulgate regulations to provide technical guidance to local education agencies which must undertake activities to test for and mitigate radon in school buildings, and establish a radon testing and mitigation assistance program under which local education agencies may apply for federal financial assistance to pay a portion of the cost of compliance activities. In turn, EPA regulations must (at a minimum) require that local education agencies complete radon testing in school buildings located in areas identified as having elevated levels of radon no later than September 30, 1993; utilize only approved radon measurement devices, mitigation methods, and mitigation contractors; make any test results available in the administrative offices of the local education agency with jurisdiction over the school building for inspection by the public; notify parent, teacher, and employee organizations of the availability of any test results; and send any test results to the EPA Administrator and to the state radiation office. Finally, the proposed legislation would provide for the imposition of a civil penalty against a local education agency which failed to conduct any radon testing required by the legislation and extend to any person the right to file a complaint with the EPA Administrator or with the governor of a state in which a school building is located with respect to a violation arising out of the alleged failure of a local education agency to comply with the provisions in the bill.

III. MANDATORY RADON TESTING AND EPA REGULATIONS

NSBA believes that the mandate currently contained in S. 1697, that local education agencies complete radon testing in each school building under its jurisdiction that is in an area identified as having elevated levels of radon, is both unreasonable and unworkable. This is so for seven reasons.

First, the 1988 Amendments to the Toxic Substances Control Act adding Title III, Indoor Radon Abatement (P.L. 100-551), require EPA to undertake a nationwide survey which characterizes the extent of radon contamination in schools in each state (15 U.S.C. 2667[a][4]). The law does not establish a date by which EPA must complete the survey. Nevertheless, under the proposed legislation, EPA is not obligated to promulgate regulations on which local education agencies may rely to undertake radon testing and mitigation until the nationwide radon survey is completed. As of May 16, 1990, EPA stated that it had collected data on radon surveys conducted in only 25 of the 50 states. If one assumes that EPA will require an additional 19 months to collect survey data on the remaining 25 states, the survey will not be completed until December 1991, and regulations promulgated until 1992.

Second, under the bill, each local education agency must test each school building under its jurisdiction that is in an area identified as having elevated levels of radon. Presumably, EPA

will use the nationwide radon survey to identify those areas with elevated levels of radon. Because that is so, until EPA has completed the survey and published the results, a local education agency will be unable to predict which school buildings under its jurisdiction (if any) are subject to the radon testing requirement.

Third, in the absence of EPA regulations upon which local education agencies may rely, no local education agency which currently undertakes radon testing and mitigation may do so and be assured that such activities will satisfy the requirements of future EPA regulations.

Fourth, the proposal provides that radon testing in school buildings must be conducted by a firm or individual approved "... by the (EPA) Administrator pursuant to the voluntary proficiency program ... or by a state pursuant to a state radon proficiency program." Nevertheless, a recent report by the General Accounting Office (GAO) suggests that the reliability of current radon measurement proficiency programs is uncertain and that significant changes to these programs are needed to ensure that companies do not provide building owners with inaccurate results.

It is not unreasonable to assume that in an effort to protect building occupants from industry malfeasance, EPA will respond to the GAO report by making significant changes to the proficiency

program which result in many radon measurement devices and laboratories losing their "approved" status. However, until EPA implements such changes, a local education agency which tests for the presence of radon using currently approved devices or methods cannot do so and be confident that such methods or devices will satisfy future EPA regulatory requirements.

Fifth, the proposal requires that local education agencies which undertake mitigation activities utilize the services of an approved mitigation contractor. EPA published the first list of radon mitigation contractors under the Radon Contractor Proficiency Program on May 15. The list currently contains the names of only 600 individuals or firms who have successfully completed the requirements of the contractor proficiency program. It is currently unknown how many of those firms are available to local education agencies to conduct mitigation activities.

The proposed legislation does not specifically require that local education agencies undertake mitigation activities in response to elevated radon levels. Nevertheless, once a local education agency discovers elevated radon levels in a school building under its jurisdiction it must conduct mitigation activities, or be in the unenviable position of operating a health hazard. Because that is so, in the absence of approved mitigation contractors in sufficient numbers to accommodate the needs of 96,000 individual school buildings, the requirement that mitigation activities be

conducted by such individuals will most assuredly operate to at once both unnecessarily impede mitigation and subject local education agencies to unwarranted legal liability.

Sixth, although the proposal would establish a radon testing and mitigation assistance program under which certain local education agencies may receive some financial assistance to conduct radon testing, it is unreasonable to assume that local education agencies, state governors and EPA will be in a position to fulfill their individual responsibilities under the application process until at least 1991. Nevertheless, because EPA has determined that initial and follow-up radon testing should be conducted during the winter months (and confirmatory measurements taken over a 9-12 month period), a local education agency which received radon testing funds in 1991 could not be expected to complete testing until the winter of 1993-94.

Seventh, state law generally requires that local education agencies operate on a fiscal year (June 1 - June 1), balanced budget basis. In that regard, many local education agencies are legally incapable of expending funds for unbudgeted items or activities. Therefore, local education agencies which have not included radon testing in their fiscal year 1990-91 budget will not have an opportunity to include the cost of such activity in their budget until fiscal year 1991-92. Again, because EPA has determined that initial and follow-up radon testing should be

conducted during the winter months (with confirmatory measurements taken over a 9-12 month period), a local education agency which includes the cost of radon testing in their fiscal year 1991-92 budget could not be expected to complete such testing until the winter of 1993-94.

IV. FINANCIAL ASSISTANCE

Under the proposed legislation, a radon testing and mitigation assistance program would be established within EPA to provide financial assistance (in the form of a loan or grant) to local education agencies for the purpose of conducting radon testing and mitigation. Although the radon assistance program generally comports with financial assistance programs available to local education agencies under other federal environmental statutes, the proposal contains two significant deviations which are of concern to NSBA.

First, unlike other financial assistance programs, a local education agency may not submit an application for financial assistance directly to EPA. Rather, all applications must be submitted to the governor who, in turn, must complete certain activities in a timely and meaningful manner before it is finally submitted to EPA. No sanction is imposed on a governor who fails to actively participate in the application process. However, local education agencies located in a state where the governor

fails (or refuses) to participate in the application process are ineligible for loan or grant award consideration. NSBA believes that this requirement places undue reliance on the governor and unfairly penalizes local education agencies for the conduct of a third party over which they have no control.

Second, under the proposed legislation, repayments of loan awards to local education agencies would be made directly to the Secretary of the Treasury for deposit in the general fund and would not be available for use by other needy schools. While it is true (as the sponsors of the bill have pointed out) that the level of authorizations currently contained in the Act should be sufficient to address the cost of radon testing in many needy schools, the history of federal appropriations to fund school-based environmental programs does not support a conclusion that future appropriations will match the radon assistance program authorization.

V. RECOMMENDATIONS AND CONCLUSION

The purpose of the proposed legislation is to assure that building occupants enjoy an environment free from the radon health hazard. However, NSBA believes that the bill currently discourages local education agencies from voluntarily undertaking the radon testing and mitigation activities that form the foundation for such an assurance.

For the reasons discussed above, the interests of a local education agency and building occupants are not necessarily well served if radon testing and mitigation are undertaken in the absence of final EPA regulations governing such activities. Moreover, local education agency experience with federal asbestos law suggests that until EPA has issued final regulations governing compliance with an environmental hazard, activities performed according to previously issued EPA guidance documents may have to be repeated, at significant expense to local taxpayers. Because that is so, we urge the Subcommittee to consider amendments to the bill which we believe would enhance achievement of the desired result of the legislation.

First, the proposed legislation should direct EPA to immediately promulgate regulations on which local education agencies may rely to test for radon and conduct mitigation activities.

Second, the requirement that each local education agency complete radon testing in each school building under its jurisdiction that is located in an area identified as having elevated levels of radon should not be effective until three years from the date EPA promulgates regulations identifying such areas in the state in which the local education agency is located.

Third, the bill should direct EPA to immediately establish a radon testing and mitigation program within EPA to provide both

technical and financial assistance to local education agencies. GAO has stated that twenty-two states have no plans to establish a radon program to assist local education agencies. In that regard, NSBA believes that it is unreasonable to assume that local education agencies in states which have no radon program will be positioned to unilaterally complete testing and mitigation activities without the advice and financial assistance of EPA.

Fourth, with respect to the requirement that the governor actively participate in the financial assistance application process, NSBA urges that the proposed legislation be amended to either delete provisions which require the governors participation in the process, or to provide for the imposition of a civil penalty on any governor who does not participate in the application process in a timely and meaningful manner. Any civil penalty imposed and collected under such a provision should, in turn, be made available to local education agencies in the governor's state for radon testing and mitigation activities.

Fifth, NSBA urges that the bill be amended to provide that all loan repayments under the radon testing and mitigation assistance program be deposited in a revolving fund from which EPA may make future loans and grants under the program.

In conclusion, NSBA would like to thank the Subcommittee and, in particular, Senator Lautenberg for the interest and assistance it has shown in the important task of assuring that the nation's schools are free of environmental hazards. In that regard, NSBA appreciates the opportunity extended to it by Senator Lautenberg to work with him to effect a radon bill that is capable of achieving the desired results in a practical and reliable manner.

II

101ST CONGRESS
1ST SESSION

S. 1697

To require local educational agencies to conduct testing for radon contamination in schools, and for other purposes.

IN THE SENATE OF THE UNITED STATES

SEPTEMBER 28 (legislative day, SEPTEMBER 18), 1989

Mr. LAUTENBERG (for himself, Mr. CHAFFEE, Mr. BRADLEY, Mr. MOYNIHAN, Mr. LIEBERMAN, Mr. CONRAD, Mr. HEINZ, Mr. PELL, and Mr. DODD) introduced the following bill; which was read twice and referred to the Committee on Environment and Public Works

---

A BILL

To require local educational agencies to conduct testing for radon contamination in schools, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Radon Testing for Safe Schools Act".

SEC. 2. REQUIREMENT FOR NATIONWIDE RADON TESTING IN SCHOOLS.

(a) TESTING BY LOCAL EDUCATIONAL AGENCIES.—After completion of the testing required by section 307(a)(4)

of the Toxic Substances Control Act (15 U.S.C. 2667(a)(4)), the Administrator shall promulgate regulations requiring each local educational agency to test each school building under the authority of the agency that is in an area identified as having elevated levels of radon. The testing required by this subsection shall be completed no later than September 30, 1993.

(b) AVAILABILITY OF RESULTS.—In the case of any school building that is tested pursuant to this section, the results of the testing shall be available in the administrative offices of the local educational agency with authority over the school building for inspection by the public, including teachers, other school personnel, and parents. The local educational agency shall notify parent, teacher, and employee organizations of the availability of such results and shall send the results to the Administrator and to the State radiation office.

SEC. 3. TESTING AND MITIGATION.

Testing required under section 2 and any radon mitigation devices and methods which are implemented as a result of such testing shall be carried out consistent with any guidelines established by the Administrator and conducted by a firm or individual which has been approved—

(1) by the Administrator pursuant to the voluntary proficiency program established pursuant to section

305(a)(2) of the Toxic Substances Control Act (15 U.S.C. 2665(a)(2)), or

(2) by a State pursuant to a State radon proficiency program.

SEC. 4. FINANCIAL ASSISTANCE.

(a) RADON TESTING AND MIGITATION ASSISTANCE PROGRAM.—There is hereby established within the Environmental Protection Agency a Radon Testing and Mitigation Assistance Program (hereinafter in this Act referred to as the "Assistance Program"), to provide financial assistance to implement the program established by section 2 and for any radon mitigation devices and methods determined to be necessary as a result of such testing. The Assistance Program shall be administered in accordance with this section.

(b) SUBMISSION OF APPLICATIONS.—(1) Applications for financial assistance shall be submitted by a local educational agency to the Governor, or the Governor's designee, who shall establish a priority list based on the nature and magnitude of the potential exposure to radon.

(2) Applications shall be submitted by the Governor to the Administrator who shall review and rank such applications, without regard to the public or private nature of the school involved, pursuant to subsection (c)(1) and propose financing pursuant to the financial need of the local educational agency.

(c) ADMINISTRATOR'S REVIEW.—(1) The Administrator shall review and list in priority order applications for financial assistance. In ranking applications, the Administrator shall consider—

(A) the priority assigned to the testing or mitigation program by the Governor;

(B) the nature and magnitude of the potential exposure to radon; and

(C) the extent to which the testing or mitigation proposed by the applicant is cost-effective compared to other techniques.

(2) In determining whether an applicant is eligible for assistance, and the nature and amount of financial assistance, the Administrator shall consider the financial resources available to the applicant as certified by the Governor.

(d) FINANCIAL NEED.—In no event shall financial assistance be provided under this Act to an applicant if the Administrator determines that such applicant has resources adequate to support an appropriate radon testing or mitigation program.

(e) LOANS AND GRANTS.—(1) An applicant for financial assistance may be granted a loan of up to 100 percent of the cost of a testing or mitigation program or, if the Administrator determines the applicant is unable to undertake and complete a testing or mitigation program with such a loan, such

applicant may also receive a grant (alone or in combination with a loan) not to exceed 50 percent of the total cost of the testing or mitigation program, in the amount which the Administrator deems necessary.

(2) In approving any grant, the Administrator shall state with particularity the reasons why the applicant is unable to undertake and complete the testing or mitigation program with loan funds.

(f) LOAN AGREEMENTS.—Loans under this section shall be made pursuant to agreements which shall provide for the following:

(1) The loan shall not bear interest.

(2) The loan shall have a maturity period of not more than twenty years (as determined by the Administrator) and shall be repayable during such period, at such times, and in such amounts as the Administrator may specify in the loan agreement.

(3) Repayment shall be made to the Secretary of the Treasury for deposit in the general fund.

(4) Such other terms and conditions that the Administrator determines necessary to protect the financial interest of the United States.

(g) APPLICATION REQUIREMENTS.—(1) No financial assistance may be provided under this section unless an appli-

cation has been submitted to the Administrator in accordance with any procedures developed by the Administrator.

(2) The Administrator shall not approve an application unless—

(A) the application contains such information as the Administrator may require, including but not limited to information describing—

(i) the nature and extent of the radon problem for which the assistance is sought;

(ii) the methods which will be used to test for or mitigate radon contamination;

(iii) the amount and type of financial assistance requested;

(iv) a description of the financial resources of the local educational agency; and

(v) a justification for the type and amount of the financial assistance requested;

(B) the application contains a certification that all activities to be conducted with the financial assistance will be performed in accordance with section 3 of this Act; and

(C) the application contains assurances that the local educational agency will furnish such information as the Administrator requires.

SEC. 5. REGULATIONS.

The Administrator shall promulgate rules and regulations as necessary to implement the authorities and requirements of this Act.

SEC. 6. ANNUAL REPORT.

During each of the six calendar years after the year in which this Act is enacted, the Administrator shall prepare and submit not later than June 1 of each year to the Committee on Environment and Public Works of the Senate and the Committee on Energy and Commerce of the House of Representatives a report on the loan and grant program authorized by section 4. The report shall—

(1) describe the number of applications received;

(2) describe the number of loans and grants made in the current calendar year and specify each applicant for and receipt of a loan or grant;

(3) specify the number of loan or grant applications which were disapproved during the current calendar year and describe the reasons for such disapprovals;

(4) describe the types of programs for which loans or grants were made;

(5) specify the estimated total costs of such programs to the recipients of loans or grants and specify the amount of loans or grants made under the assistance program; and

(6) estimate the number of schools still in need of assistance, including schools not located in an area identified as having elevated levels of radon, and the amount of resources needed by such schools, categorized by State, to mitigate all remaining school radon contamination.

SEC. 7. ENFORCEMENT.

(a) CIVIL PENALTIES.—Any local educational agency which fails to conduct the testing required pursuant to this Act or which knowingly submits false information regarding such testing to the Governor is liable for a civil penalty of not more than $500 for each day during which the violation continues. For purposes of this subsection, "violation" means a failure to comply with respect to a single school building. The court shall order that any civil penalty collected under this subsection be used by the local educational agency for purposes of complying with this subsection.

(b) AMOUNT OF PENALTY.—In determining the amount of a civil penalty to be assessed under this section against a local educational agency, the Administrator shall consider—

(1) the significance of the violation;

(2) the culpability of the violator, including any history of previous violations under this Act;

(3) the ability of the violator to pay the penalty; and

(4) the ability of the violator to continue to provide educational services to the community.

(c) ASSESSMENT OF PENALTY.—A civil penalty for a violation of this Act shall be assessed by the Administrator by an order made on the record after opportunity for a hearing in accordance with section 554 of title 5, United States Code. Before issuing such an order, the Administrator shall give written notice to the person to be assessed a civil penalty under such order of the Administrator's proposal to issue such order and provide such person an opportunity to request, within fifteen days after the date on which notice is received by such person, such a hearing on the order.

(d) MODIFICATION OF PENALTY.—The Administrator may compromise, modify, or remit, with or without conditions, any civil penalty which may be imposed under this subsection. The amount of such penalty, when finally determined, or the amount agreed upon in compromise, may be deducted from any sums owing by the United States to the person charged.

(e) JUDICIAL REVIEW.—Any person who requested in accordance with this section a hearing respecting the assessment of civil penalty and who is aggrieved by an order assessing a civil penalty may file a petition for judicial review of such order with the United States Court of Appeals for the District of Columbia Circuit or for any other circuit in which

such person resides or transacts business. Such a petition may only be filed within the thirty-day period beginning on the date the order making such assessment was issued.

(f) FAILURE TO PAY CIVIL PENALTY.—If any person fails to pay an assessment of a civil penalty—

(1) after the order making the assessment has become a final order and if such person does not file a petition for judicial review of the order in accordance with this section, or

(2) after a court in an action brought under this section has entered a final judgment in favor of the Administrator,

the Attorney General shall recover the amount assessed (plus interest at currently prevailing rates from the date of the expiration of the thirty-day period referred to in subsection (e) or the date of such final judgment, as the case may be) in an action brought in any appropriate district court of the United States. In such an action, the validity, amount, and appropriateness of such penalty shall not be subject to review.

(g) CITIZEN COMPLAINTS.—Any person may file a complaint with the Administrator or with the Governor of the State in which the school building is located with respect to radon in a school building. If the Administrator or Governor receives a complaint under this subsection containing allega-

tions which provide a reasonable basis to believe that a violation of this subsection has occurred, the Administrator or Governor shall investigate and respond (including taking enforcement action where appropriate) to the complaint within a reasonable period of time.

SEC. 8. PREEMPTION.

(a) CONSTRUCTION OF PROVISIONS AS NOT PREEMPTING OTHER LAWS.—Nothing in this Act shall be construed, interpreted, or applied to preempt, displace, or supplant any other State or Federal law, whether statutory or common.

(b) AWARD OF COSTS AND DAMAGE AWARDS.—Nothing in this Act shall be construed or interpreted to preclude any court from awarding costs and damages associated with the testing or mitigation of radon contamination, or a portion of such costs, at any time.

(c) CONSTRUCTION OF PROVISIONS AS NOT PROHIBITING MORE STRINGENT STATE REQUIREMENTS.—Nothing in this Act shall be construed or interpreted as preempting a State from establishing any liability or more stringent requirements with respect to radon in school building within such State.

(d) CREATION OF CAUSE OF ACTION.—Nothing in this Act creates a cause of action or in any other way increases or diminishes the liability of any person under any other law.

(e) EFFECT OF PROVISIONS IN CIVIL ACTIONS FOR DAMAGES.—It is not the intent of Congress that this subsection or rules, regulations, or orders issued pursuant to this subsection be interpreted as influencing, in either the plaintiff's or defendant's favor, the disposition of any civil action for damages relating to radon. This subsection does not affect the authority of any court to make a determination in any adjudicatory proceedings under applicable State law with respect to the admission into evidence or any other use of this Act or rules, regulations, or orders issued pursuant to this Act.

SEC. 9. DEFINITIONS.

In this Act:

(1) The term "Administrator" means the Administrator of the Environmental Protection Agency.

(2) The term "local educational agency" means—

(A) any local educational agency as defined in section 198 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 2854),

(B) the owner of any private, nonprofit elementary or secondary school building, and

(C) the governing authority of any school operated pursuant to section 6 of the Act of September 30, 1950 (64 Stat. 1107), relating to

impact aid for children who reside on Federal property.

(3) The term "nonprofit elementary or secondary school" means any elementary or secondary school (as defined in section 198 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 2854)) owned and operated by one or more nonprofit corporations or associations no part of the net earnings of which inures, or may lawfully inure, to the benefit of any private shareholder or individual.

(4) The term "radon" means the radioactive gaseous element and its short-lived decay products produced by the disintegration of the element radium occurring in air, water, soil, or other media.

(5) The term "school building" means—

(A) any structure suitable for use as a classroom, including a school facility such as a laboratory, library, or school eating facility used for the preparation of food,

(B) any gymnasium or other facility which is specially designed for athletic or recreational activities for an academic course in physical education,

(C) any other facility used for the instruction of students or for the administration of educational or research programs.

SEC. 10. AUTHORIZATION.

(a) TESTING.—There is authorized to be appropriated to the Administrator not more than $5,000,000 for purposes of carrying out testing required by this Act. Such amount shall remain available for expenditure until September 30, 1993.

(b) MITIGATION.—There is authorized to be appropriated to the Administrator not more than $5,000,000 for each of the fiscal years 1992, 1993, 1994, 1995, and 1996 for the purposes of implementing any radon mitigation devices or methods determined to be necessary as a result of testing carried out under section 2 of this Act.